Saving Energy in Local Government Buildings

A Report by the Audit Commission in collaboration with the Energy Efficiency Office of the Department of Energy

November 1985

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Summary

In 1983–84, local authorities in England and Wales spent about £1,000 million on energy, representing about 5% of national energy usage. Of this, about £800 million was spent on non-domestic buildings such as offices, schools, elderly persons' homes, libraries and leisure centres. A typical district council operates about 50 significant buildings and spends £0.5 million per annum on energy, a metropolitan or London borough spends about £4 million and a typical county council will operate about 1,000 buildings and spend about £7 million. Such expenditure on energy represents around 10% of the non-staff-related running costs of the authority, and offers a ready opportunity for saving money.

The Commission estimates that savings worth about £135 million a year are possible without adversely affecting the comfort of building users or the standards of service offered to the public. The potential savings, of 12 to 17%, are proportionally smaller than are reportedly available in the National Health Service or within the Ministry of Defence – reflecting the attention that has already been devoted to energy conservation by many local authorities.

The technical measures – such as insulation and better controls – which improve the energy efficiency of the buildings and heating and lighting plant are quite well tried and tested, although their application has tended to be *ad hoc* and piecemeal. Previous reviews of energy efficiency in local authorities, such as the 1982 review by Local Authorities Management Services and Computer Committee (LAMSAC), have shown that what is needed is a more organised approach to the application of these measures and an effective approach to the management of energy, including improved management information systems.

Consequently, the Audit Commission and the Energy Efficiency Office of the Department of Energy have collaborated on a special study of energy management in local authorities' non-domestic buildings, with the aim of identifying good practice. Next year, auditors will be working with individual local authorities to assist them in harnessing the opportunities available; in many cases these have been found to exceed 15% of the energy budget.

The special study reviewed energy management in 30 authorities and extracted data on energy consumption in over 3,000 buildings. The study reveals a wide range in the energy efficiency of individual buildings and entire stocks of buildings, with approximately a 2:1 ratio between the best and the worst after taking account of factors such as local climate and hours of use of the building. If all buildings could be brought up to the efficiency yardsticks established by the study, then in some currently poor authorities the total energy consumption could be reduced by a third. In other authorities, the buildings are already more efficient than the yardsticks. These are authorities that over the last five to ten years have committed significant manpower effort to developing and managing a programme of building improvements and to increasing the level of energy awareness among building users. Universal application of this and other good practices outlined in this report would eventually result in savings of at least £100 million and probably £135 million a year with no reduction in the comfort level of building users or the standards of service offered to the public.

A proportion of these savings will be achieved if the current effort by some authorities continues. However, to achieve the full potential, authorities will need to build up their annual investment in energy efficiency measures over the next five years, from an estimated £40m per annum now for England and Wales to about £80m per annum. Whilst there is a limit to the number of years for which this level of investment needs to be sustained, the savings will continue year after year. Properly managed, an energy investment programme can be self-financing.

The main recommendations of this report are summarised in Exhibit 1. They are:

- Every authority should produce an energy policy statement. This should cover the procedures for controlling energy consumption and guidelines for an investment programme to improve the efficiency of buildings and plant. Efforts should concentrate initially on the 20% of the buildings which account for the bulk of the energy spend, typically 70%. An annual report should be presented to the council summarising progress and future plans. As an initial objective, a 20% reduction in energy consumption within five years is likely to be feasible in many authorities which have not devoted major efforts to conserving energy.
- Capital investment in energy efficiency schemes warrants special consideration. Such schemes are in effect revenue earners. In contrast, most other capital investments require continuing revenue outlay to support them. Particularly attractive to authorities constrained for capital is a new scheme for provision of finance – and expertise – by energy service companies, which then share in the resultant savings at an agreed rate and period.
- It is cost effective for authorities to build up over a period of a few years to a position where they are investing at least 10% of their energy spend per annum in technical measures to improve energy efficiency. Schemes with payback periods of less than two years can be readily identified, and schemes with payback periods of about six years or less will nearly always represent worthwhile investments.
- Authorities spending more than about £750,000 a year on energy in their non-domestic buildings should establish a small central energy management unit, comprising about one person per £1m energy spend. Smaller authorities should have a part-time energy officer. This energy management unit or officer should act as the focal point for the collection and analysis of data on energy consumption, and develop and manage a long-term programme of energy efficiency improvements.
- Appropriate incentives are necessary to persuade committees and staff to take energy conservation seriously. The most obvious incentive is to allow those generating the savings to benefit directly from them. Distinction should be made between savings from technical measures and those from good housekeeping by the building's users and staff, such as closing doors and windows and turning off lights. It is important to get the incentives right. Yet in many authorities, spending committees are expected to allocate the capital for energy efficiency measures but their revenue budgets are then cut to reflect the assumed savings.
- More effort should be devoted to involving and motivating the

Exhibit 1

KEY FEATURES OF GOOD ENERGY MANAGEMENT PRACTICE

VISION

- Council Members should agree a policy statement setting out the principles for controlling energy consumption and guidelines for an investment programme to improve the energy efficiency of the buildings. This should set out quantifiable guidelines e.g. "the intention is to reduce total energy consumption by 20% over a 5 year period by investing £200,000 p.a."

STRATEGY

- Each year invest at least 10% of the energy budget in a programme of building and plant improvements
- Implement a programme of training and publicity aimed at building users
- Concentrate initially on the 20% or so of buildings which account for the bulk, typically 70%, of the energy spend

STRUCTURE

- Establish a central energy management unit or officer, depending on size, to monitor consumption, develop and manage the programme of improvements and raise the level of energy awareness among building users

STYLE

- Involve building users and staff
- Consider incentives to building establishments and staff which allow them to retain part of any savings
- Ensure that current budgetary procedures do not discourage spending committees from investing in energy measures

SYSTEMS

- Set targets for energy consumption in all significant buildings and monitor against target using a monitoring and targetting system, computer-based if more than 50 buildings.
- Present Council Members with an annual report setting out achievements and future plans
- Tariff analysis

SKILLS/STAFFING

- Devote about 1 person per £1m energy spend to the central management of energy building users and staff. Good housekeeping by these can achieve savings at least equal to those achievable from technical measures. Training and publicity are necessary.

- Targets for energy consumption should be set for all large buildings and consumption should be closely monitored against target. To facilitate this, authorities should install a central energy monitoring and targeting system, such as the LAMSAC system developed under the auspices of the Department of Energy. This can be a manual system if less than 50 buildings are being monitored, otherwise it should be computerised.

Introduction

1. In 1983–84 local authorities in England and Wales spent £1000m on energy, representing about 5% of the national energy usage. Of this, about £800m was spent on non-domestic buildings. About a third of the energy use was from gas, another third from oil, a quarter from electricity and the remainder from coal. The average non-domestic building energy spend of each type of authority is shown in Table 1. For a county the average expenditure is £6.6m a year, while for a shire district it is £450,000. There are considerable variations about each average; districts in rural areas can have an annual energy spend less than £200,000; county councils can have a spend in excess of £10m a year. This variation reflects the different numbers and types of buildings owned, as well as the different types and levels of service provided.

Table 1: EXPENDITURE ON ENERGY IN LOCAL AUTHORITIES' NON-DOMESTIC BUILDINGS, FY 1984* ENGLAND AND WALES, £m

Type of authority	Average per authority	Estimated total	Apparent savings potential
County councils	6.6	360	35 – 55
Metropolitan districts and London boroughs	4.0	280	35 – 50
Shire districts	0.45	150	30
		790	100–135

Source: 1985 Special study. Metropolitan county councils were not covered in the special study. The table above includes estimates for them based, among other sources, on a LAMSAC study carried out in 1982.

2. In all authorities the energy spend represents a significant proportion (5–20%) of the non-staff-related running costs of the authority, i.e. excluding employment costs and capital charges. By managing the use of energy more effectively, revenue savings can be made without any loss of employment or reduction in standards of service and comfort: in recent years a number of authorities have reduced their energy consumption by 20% or more. This has been achieved by motivating building users and staff to conserve energy and by implementing programmes of technical measures to improve the energy efficiency of buildings and plant.

3. Appropriate technical measures are well tried and tested although, in the past, the exchange of technical information between authorities has been limited. However, lack of technical information is no longer a major constraint to progress within local government. What appears to be lacking in many authorities is a disciplined and determined approach – by members and officers – to realising the potential for savings. The Energy Efficiency

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*FY 1984 is the financial year ending 31 March 1984

Office (EEO) of the Department of Energy considered that what was most needed by local authorities was advice on the effective approach to controlling energy consumption and implementing a programme of improvements.

4. Accordingly, the EEO agreed to collaborate with the Audit Commission on a special study with the objective of identifying good energy management practice. The special study commenced in January 1985 and was largely financed by the EEO. The fieldwork and analysis were undertaken by PA Management Consultants, who have considerable previous expertise in this area both in local government and the private sector. The local authority associations were consulted throughout the course of the study and provided valuable comments. This report has been prepared by the Audit Commission based on material from the special study and previously published work listed in Appendix A. Responsibility for its contents, however, rests with the Commission, who wish to express their thanks to the above bodies and to the members and officers in the 18 authorities studied in depth during this work.

5. The study was concerned with the energy use of local authority non-domestic buildings which include offices, schools, further education establishments, libraries, leisure centres, elderly persons' homes, depots, etc. Such expenditure typically constitutes 80% of the total energy bill for a county, and between 50 and 75% for a shire district. Energy used for street lighting, transport, buses, refuse burning, pumping and in council dwellings other than sheltered housing has been excluded because its management requires a somewhat different approach. Energy for transport was covered in the Audit Commission report *Improving Vehicle Fleet Management in Local Government*, HMSO, 1984. In reviewing the energy efficiency of buildings the study has concentrated on delivered energy (expressed in kWh) rather than cost. Cost depends on the fuel used and the relative prices of different fuels tend to change from one decade to another. Efforts to reduce the delivered energy consumption of buildings will be beneficial whatever fuel is used, although authorities certainly need to be alert to fuel price differentials.

6. This report draws on information from 30 authorities. Eighteen were studied in depth by the study team (the host authorities) and 12 were reviewed by auditors as part of their normal value for money review to test the proposed audit appoach that had emerged from the special study. The 18 host authorities (Appendix B) were selected in the expectation that they would be among the more efficient authorities nationally. At the time there were no quantitative indicators of performance by which to judge efficiency; therefore the selection was necessarily somewhat subjective, although less so in the case of the large authorities, many of which had an established national reputation for energy management. The 12 authorities reviewed by auditors were in effect a control group and were expected to be a fairly representative mixture of authorities. From each authority information was extracted on energy consumption for most of the large buildings, accounting for 65% of the total energy spend of the authority on non-domestic buildings. In total, information on about 3,200 buildings from 30 authorities has been assembled.

7. This data has been used to define and quantify performance indicators to assess the energy efficiency of an authority's building stock. These performance indicators have permitted a consistent comparison to be made of the effectiveness of different authorities' approaches to energy management and hence have facilitated the identification of good practice and the range in performance. They can also be used by individual authorities to assess the efficiency of their own buildings – the procedure is

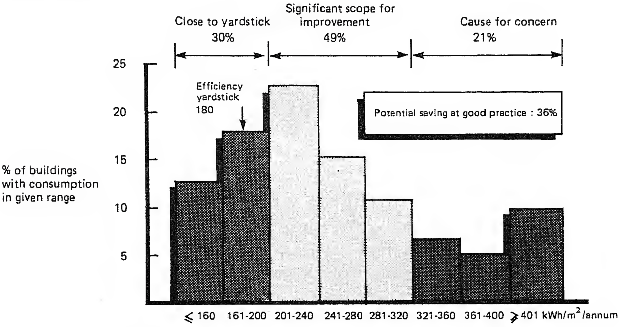
described in detail in the audit guide to be made available in December 1985*.

8. The study reveals that there is a considerable range in the amount of energy consumed by buildings that are used for similar purposes. For example, the top figure in Exhibit 2 below shows the range in energy consumption for almost 1,000 primary schools without an indoor pool in the sample. To make comparisons fair, the energy consumption has been adjusted for the number of hours of use, the degree of exposure of the building, the prevailing weather conditions and the floor area of the building. An energy efficient primary school used for 1,480 hours a year will consume about 180 kWh per square metre of floorspace per annum (abbreviated to kWh/m^2/annum), but about a fifth of schools consume over 320 kWh/m^2/annum for the same hours of use – nearly twice the amount of the efficient schools. The study also reveals wide differences in the relative

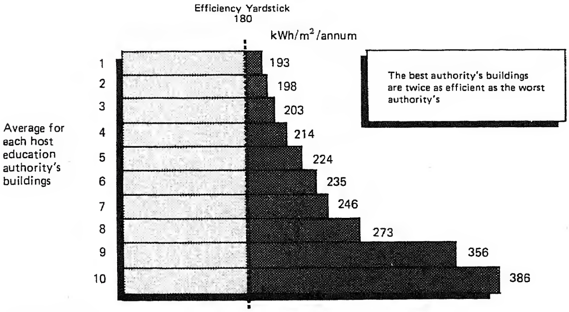
Exhibit 2

ANNUAL, NORMALISED ENERGY CONSUMPTION IN PRIMARY SCHOOLS WITH NO INDOOR POOL

kWh/m^2/annum



Source: Study Team Analysis of information from 17 LEAS (total of 996 buildings)



Source: Study Team Analysis of information from 10 host LEAS

**Audit Guide on the Management of Energy in Local Authority Buildings*, December 1985, can be obtained from the Audit Commission, St. Lawrence House, 29–31 Broad Street, Briston, BS1 2EX, price £8 (payment with order).

energy efficiency of different authorities' building stock. The bottom figure in Exhibit 2 shows the average efficiency of each host education authority's total stock of primary schools without pools. It can be seen that no authority has yet managed to get average consumption down to an efficient level of 180 kWh/m^2/annum, although three are quite close. What is startling is the 2:1 range between the best and worst authorities (193 compared with 386).

9. If all buildings could be brought up to the efficiency of the best quarter nationally, then in some currently poor authorities the total energy consumption could be reduced by more than a third. Nationally, savings of up to £135 million a year appear feasible within five years or so without detriment to comfort levels or standards of service. Such savings require all authorities to bring their buildings up close to the efficiency yardsticks established by this study. This is a relatively lenient target, and in the long term considerably higher savings may be achieved as the poor building stock is gradually replaced by buildings of a more energy-efficient design.

10. This report shows how these potential savings can be achieved. Three main steps are involved:

(i) *Recognition by members and senior officers alike that energy conservation is important* enough to deserve their serious attention. Obvious though this may seem, many authorities appear not to be taking energy management seriously; and this inevitably is resulting in unnecessary waste of an expensive and depleting resource. Chapter One describes why the Commission believes that energy management is important.

(ii) *Development of a comprehensive energy management programme* to take advantage of the local opportunities for savings. Chapter Two describes the key features of effective management observed by the study team in the host authorities. Worthwhile improvements can be realised by more general application of measures that are already in place in those authorities that take energy management seriously. Not surprisingly, the most important factor is the commitment and effort devoted to the management of energy by authorities. Some authorities devote less than 2% of their energy budget to investments in energy efficiency, compared with 10% in the authorities that have made a concerted effort to improve their efficiency. Similarly, some authorities commit very little manpower to the central management of energy, while others have central units with one person per £1m energy spend.

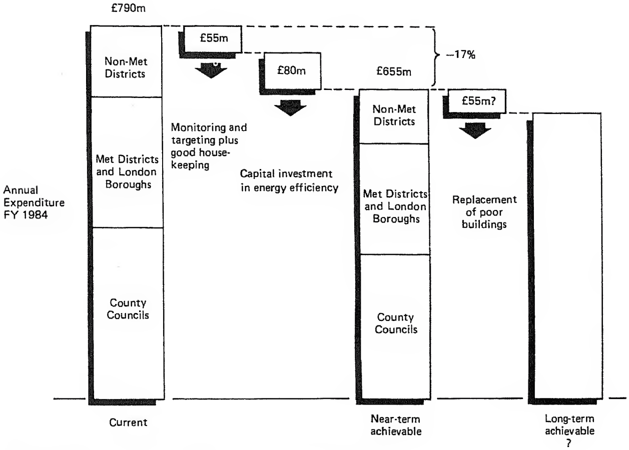
(iii) *Action* to implement the programme. It is one thing to develop an energy management programme but quite another to see it put into practice. Chapter Three describes how improvements can be introduced.

Exhibit 3 opposite suggests the stakes are large. The figures are significant in their own right: £135 million a year represents over £1 per week for every person employed in local government, or around 15% of the total expenditure on social services for the elderly, or sufficient to cater for an increase of about one-third in the number of home help hours; in a typical shire district the savings potential might enable the council to support a further leisure centre. The Commission is therefore asking auditors to examine energy management in every local authority in England and Wales during the audit round beginning in late 1985, and to work with authorities to see that the steps discussed above are taken to achieve the available savings potential.

Exhibit 3

ANNUAL COSTS OF ENERGY IN NON-DOMESTIC BUILDINGS OPERATED BY LOCAL AUTHORITIES IN ENGLAND AND WALES

Savings of up to £135 million a year appear feasible within the next 5 to 10 years, considerably more in the long-term as poor buildings are replaced.



Source: Study team analysis of potential for improvement in 30 authorities.
Paragraph 27 gives basis for forecast of potential savings.

1 The importance of energy management

11. There are three reasons why local authorities should devote more attention to the management of energy:

(i) the total costs of energy are large in absolute terms – about twice the total cost of the Fire Service for example, or comparable in scale to the total local authority expenditure on care for the elderly.

(ii) there are worthwhile opportunities for improvement. Nationally, savings of around £135 million a year appear possible given the necessary investment and management action.

(iii) there are wide differences in authorities' performance. Many local authorities have shown what can be achieved, but too often, particularly in small authorities, energy management has not received the necessary attention.

This chapter discusses each of these factors in turn.

ENERGY COSTS WARRANT ATTENTION

12. The energy expenditure of a local authority on its non-domestic building stock can range from as little as £200,000 to more than £10m per annum. The range in expenditure for the 30 study authorities is shown in Table 2. Exhibit 4 shows the typical distribution of this expenditure across the different types of building operated.

Table 2: NUMBER OF BUILDINGS AND ENERGY EXPENDITURE, FY 1984

Type of authority	Number of significant non-domestic buildings	Non-domestic building stock annual energy expenditure, £million
Non-metropolitan county councils	450 – 1,600	2.6 – 10.8
Metropolitan districts and London boroughs	150 – 415	1.4 – 5.7
Shire districts	10 – 120	0.2 – 1.2

As Table 2 shows, a shire district will have between ten and 120 significant buildings* (i.e. excluding public conveniences, car park booths, etc). These will include council offices, leisure centres and depots. A county council will have around 1,000 buildings, the majority of which will be owned by the education and social services departments (police buildings have been excluded from the study).

13. Energy expenditure on non-domestic buildings per head of population varies considerably both between the different types of authority, and within each type: from as low as £1.30 per head to as high as £20 per head. This large variation is not for the most part a reflection of the range in efficiency but rather of the different numbers and types of buildings owned

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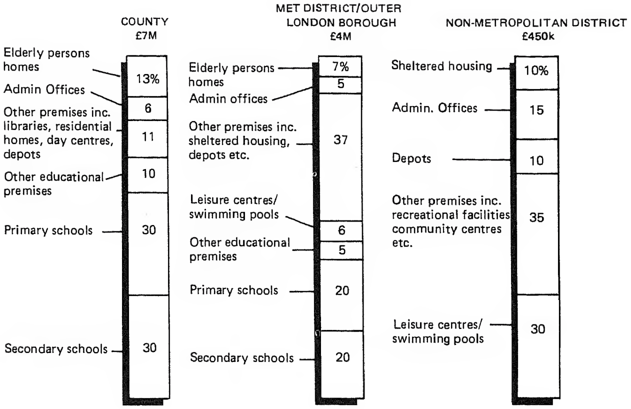
* For the purpose of this report the term building is used for both a single building and a collection of buildings on one site if these are treated as one for accounting and recording purposes.

Exhibit 4

BREAKDOWN OF ENERGY EXPENDITURE



Source: Study team analysis of data from 30 authorities

by authorities, itself a reflection of the different types and levels of service provided. Only within counties is expenditure per head any guide to overall energy efficiency, and this is because the variation in the level of services provided, and hence the number of buildings owned, is small compared with the much wider variation in energy efficiency. We discuss later how we have made a fair comparison of different authorities' efficiencies. Energy costs for individual buildings are closely related to, among other factors, the area of the building, its primary use and the hours of use. Some examples are shown in Table 3.

Table 3: ENERGY EXPENDITURE FOR SOME COMMON CATEGORIES OF BUILDING, FY 1984

	Area (m^2)	Hours of use per year	Average annual energy cost
Primary school	2,135	1,480	£ 9,000
Secondary school	7,010	1,660	30,000
College of FE	11,300	2,530	60,000
Elderly persons' home	1,390	8,760	12,000
Swimming pool	2,200	4,000	40,000
Library	850	2,540	5,000
Main office	7,500	2,600	50,000

14. The Department of Energy considers that for the nation as a whole a 20% reduction in the current level of energy consumption can be achieved, equivalent to £7 billion. Based on its 1982 study, LAMSAC considered that local authorities could probably save £100 million a year. The LAMSAC study showed that many local authorities had been slow to introduce efficiency measures and were unaware of either the energy element in running costs or the full potential for controlling bills. LAMSAC reported

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that senior officers were sometimes surprised when confronted with the information that energy formed 10% or more of running costs.

15. Authorities should pay attention to energy because a relatively small investment of time and a reasonable investment of money can make major improvements in energy efficiency, the savings from which will pay back the investment in a few years and continue to reap rewards for the authority far into the future. For example, Essex reckons to have invested £10.9 million over the period 1974 to 1984, and achieved gross cumulative savings of £26.3 million, a net saving of £15.4 million. After seven years of their energy conservation programme, Cambridgeshire reckoned to be saving 20% of its energy bill (a net saving of 13% after deducting the annual cost of the programme). As Exhibit 5 opposite shows, Dorset's consumption of energy has reduced by about 23% over five years; it is important to note that cumulative savings in Dorset have always exceeded cumulative investment and thus the investment programme has been self-financing. Leicester City reckons to have saved £200,000 over four years simply from reviewing its electricity tariffs. Numerous other examples, given later in this report, show that when authorities give attention to energy management, considerable improvements result. The CIPFA/SOLACE/LAMSAC *Value for Money Handbook*, the TESCO/LAMSAC *Management Team Awards* and the good practice guide *Energy Efficiency and Local Authorities* cite many examples of successful actions taken by local authorities, with payback periods as short as a few weeks – but more typically a few years. That these measures need to be more widely implemented is indicated by the wide range in efficiency between buildings and between authorities' building stock taken as a whole. This wide range is examined below.

WORTHWHILE OPPORTUNITIES FOR IMPROVEMENT

16. Energy consumption and expenditure are affected by a number of factors, some within the control of the authority, others beyond its direct control – see Exhibit 6 on page 14. As part of the special study, a procedure has been devised for comparing the energy efficiency of buildings of a similar category (e.g. all primary schools with no indoor pool). The procedure adjusts the total energy consumption of the building for four of the most important factors outside the immediate control of the authority: the number of hours of use, the degree of exposure of the building to the elements, the prevailing weather conditions in the locality and the floor area of the building. No robust adjustment for the type of construction of the building could be detected from the data, although this will undoubtedly also affect consumption. There was no statistically significant influence that could be detected from other external factors that might be thought to affect energy consumption, e.g. the age of the building. Full details of the procedure are given in the *Audit Guide on the Management of Energy in Local Authority Buildings* referred to earlier, and the approach is summarised in Appendix C.

17. The result of the calculation is an energy consumption expressed as kWh* per square metre of floorspace per annum, adjusted to average hours of use, normal exposure and average weather, and referred to as a Normalised Performance Indicator (NPI). In the special study NPIs were calculated for a total of 3,200 buildings from 30 different authorities. This collation and analysis of energy consumption data is a major research achievement of the special study. Exhibit 7 on page 15 shows the range in NPIs for buildings within the categories commonly found in local authorities. The range for each category has been defined statistically as

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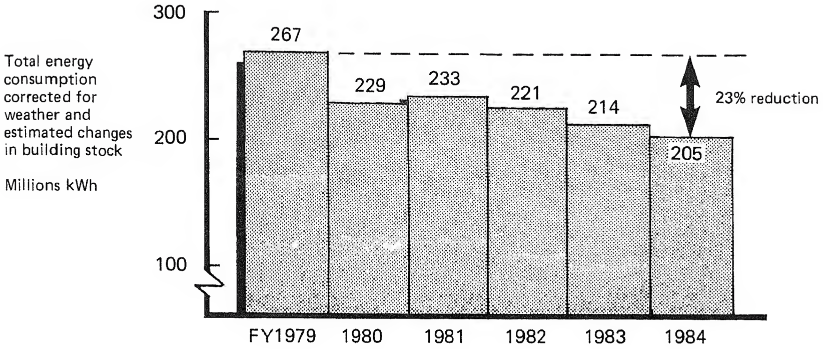
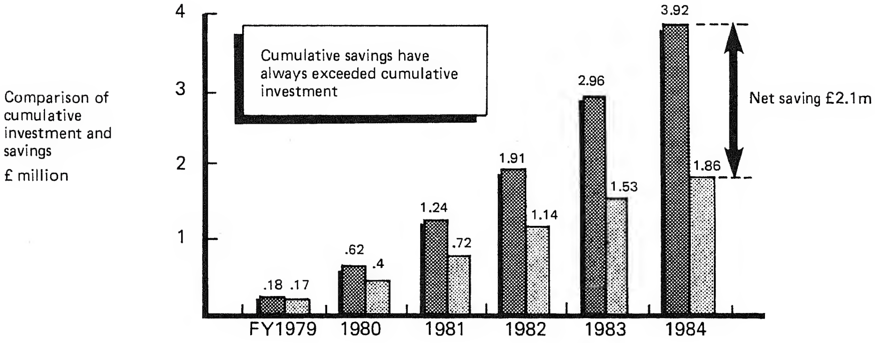
* kWh is the abbreviation for a kilowatt-hour, which is the amount of heat given off by one bar of a standard electric fire in an hour.

Exhibit 5

ENERGY CONSUMPTION IN DORSET CC



Source: Study team analysis of Dorset's data



Source: Dorset CC

KEY

▨ Cumulative savings

▨ Cumulative investment

Exhibit 6

FACTORS AFFECTING ENERGY CONSUMPTION AND EXPENDITURE

	DEMAND	SUPPLY
SHORT-TERM UNCONTROLLABLE	Basic use of building (e.g. office, school, leisure centre) Hours of use (e.g. around 2500 hours for an office, 1600 hours for a school etc) Prevailing weather/geographical location/outside temperature Exposure of building Building shape, size, structure and materials	Market prices for fuels
SHORT-TERM CONTROLLABLE	Pattern of hours of use (e.g. evening class nights) Building users' expectations/comfort levels Users' actions (e.g. shutting doors, switching off lights) Ancillary equipment Thermal efficiency of building Internal temperatures, humidity, ventilation rates, hot water temperatures Artificial lighting requirements	Design efficiency of plant, heating and cooling systems, controls and lighting Maintenance of plant Tariffs Choice of fuel Purchasing contracts

0.68 of the standard deviation either side of the mean of each category. This is the range within which 50% of the observations lie, assuming NPIs are distributed normally. Thus it is to be expected that nationally about 25% of buildings will have NPIs below the bottom and about 25% will be above the top of the ranges shown. Note that a low NPI denotes a building which consumes a small amount of energy per square metre of floorspace, and which is therefore efficient in the use of energy.

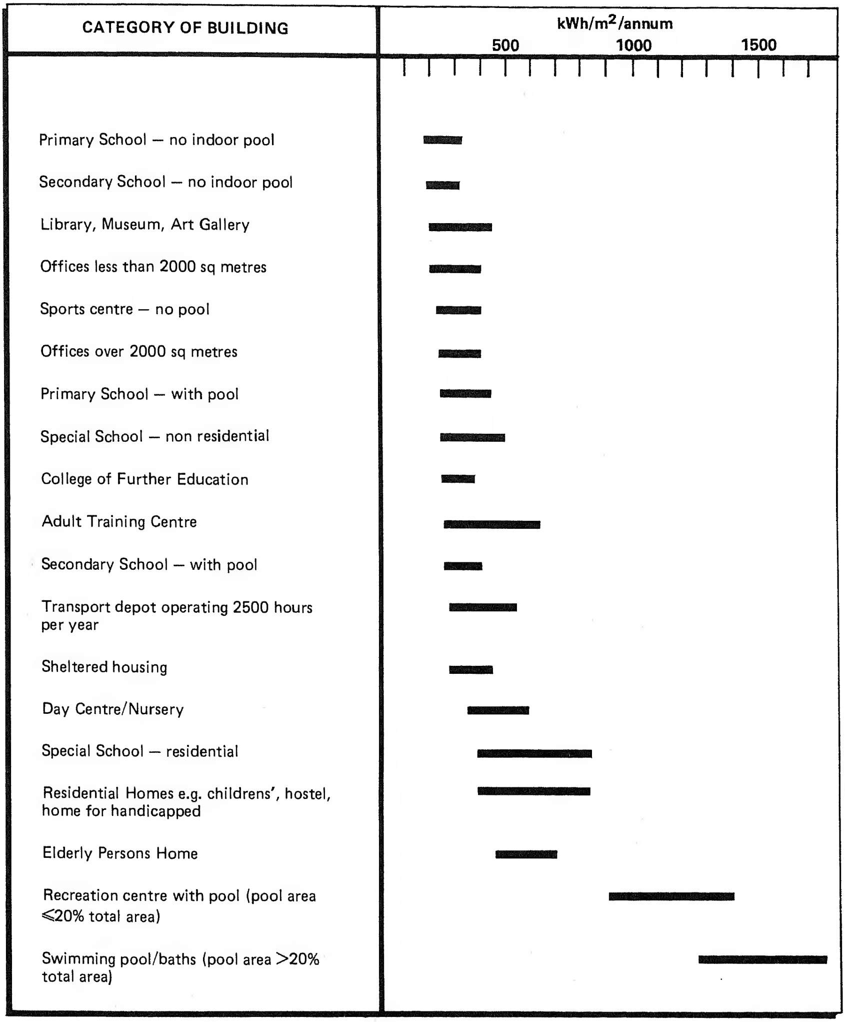
18. It can be seen from Exhibit 7 opposite that different categories of building can have markedly different consumptions. Taking the low end of the ranges, for example:

- an energy-efficient primary school in neither an exposed nor sheltered site and used for 1,480 hours per annum will consume 180 kWh per square metre per annum in a year with average weather;
- secondary schools are usually of a more energy-efficient design but since they are used for more hours per year they consume more energy than primary schools, 190 kWh per square metre per annum;
- an elderly persons' home will be used all the time (8,760 hours per annum) and will be heated to a somewhat higher tempera-

Exhibit 7

RANGE IN NORMALISED PERFORMANCE INDICATORS FOR DIFFERENT CATEGORIES OF BUILDING

Normalised performance indicator kWh/m^2/annum



ture, hence its consumption will be about 450 kWh per square metre per annum – over double the rate for a primary school;
- a swimming pool is, not surprisingly, the highest consumer at 1,250 kWh per square metre per annum.

By way of comparison, a domestic home will typically consume 280 kWh per square metre per annum.

19. It can also be seen from this Exhibit that within each category, there is approximately a 2:1 ratio between the top and bottom of each range, broadly speaking between the best quarter and worst quarter of buildings. For example, the least efficient small offices have a normalised consumption of around 400 kWh per square metre per annum, while the most efficient have 200 kWh per square metre per annum.

20. In the special study, the authorities were asked to give individual comments on the buildings identified by the above procedure as high consumers. These were nearly all buildings which had received little attention by way of technical measures, or where the building users were regarded as not particularly energy conscious. In a number of cases, the explanation was that the building had been designed and built in an era when energy efficiency received little attention from architects – something about which the authority can do little now, except to ensure that energy efficiency is a high priority in current new building design. In a few cases, the explanation for the high consumption was related to a particular activity in the building (e.g. extensive use of pottery kilns) and was not therefore indicative of inefficiency.

21. The low end of the range for each category has been used to define an efficiency yardstick which it is considered all buildings, except those of very poor original design and materials, should be able to achieve; the high end of the range has been taken as an indicator of poor efficiency. Table 4 shows these indicators; derived from analysis of energy consumption in some 3,200 buildings in 30 authorities in England and Wales.

22. The efficiency yardsticks are quite lenient since around 25% of buildings are already doing better than them. Nonetheless, on this basis the energy consumption in some buildings could be more than halved, given the right attitudes by building users and provided the right energy efficiency measures are installed. This fact has already been recognised in many authorities which have set out to improve the efficiency of their building stock. That other authorities have not been nearly as active is indicated by the range in overall energy efficiency between authorities. This is discussed below.

WIDE DIFFERENCES BETWEEN AUTHORITIES

23. The procedure outlined above can be extended to provide an indicator of the energy efficiency of the authority as a whole. For simplicity of interpretation, the indicator has been expressed as a percentage. The authority's performance rating relates the hypothetical consumption, if all the authority's buildings were as efficient as the yardsticks in Table 4, to the actual consumption. If all an authority's buildings were as efficient as the yardsticks, then the rating for that authority would be 100%. A rating above 100% shows that the authority's buildings are more efficient than the yardsticks – this is something which none of the large authorities in the study had yet achieved, although given time it should be feasible since a number of the district councils had already succeeded with their relatively smaller number of buildings. A rating of around 50% implies that the authority's buildings are among the worst quarter nationally. The rating is affected by the consistency of the building stock, and thus even in an overall poor authority some very good buildings may exist, and vice versa. Furthermore, the accuracy of the indicator will be dependent on the

Table 4: NORMALISED PERFORMANCE INDICATORS

Category of building	Standard hours of use per annum	Yardstick of efficiency kWh/m²/annum	Indicator of poor efficiency kWh/m²/annum
Primary school, no indoor pool	1,480	180	320
Primary school with indoor pool	1,480	230	440
Secondary school, no indoor pool	1,660	190	300
Secondary school with indoor pool	2,000	250	390
Special school, non-residential	1,570	230	490
College of further education	2,530	230	370
Special school, residential	8,760	380	820
Adult training centre	2,150	250	620
Elderly persons home	8,760	450	680
Day centre/Day nursery	2,200	330	590
Residential home (e.g. children's home, hostel, home for handicapped)	8,760	380	820
Sports centre, no pool	4,700	220	410
Leisure/Recreation centre with pool*	4,800	900	1,400
Swimming pool/baths**	4,000	1,250	1,750
Library/museum/art gallery	2,540	200	440
Offices over 2,000 m²	2,600	230	390
Offices less than 2,000 m²	2,400	200	400
Transport depot, operating approx. 2500 hours per annum	2,500	270	520
Sheltered housing	8,760	270	430

* Pool area less then 20% of total area
** Pool area more than 20% of total area

Source: Consumption data on about 3,200 buildings from 30 authorities analysed in the special study

number of buildings included in the sample. For county councils, metropolitan districts and London boroughs, it will be quite robust; but for small district councils it may be quite sensitive to the performance indicator for one or two buildings e.g. a leisure centre.

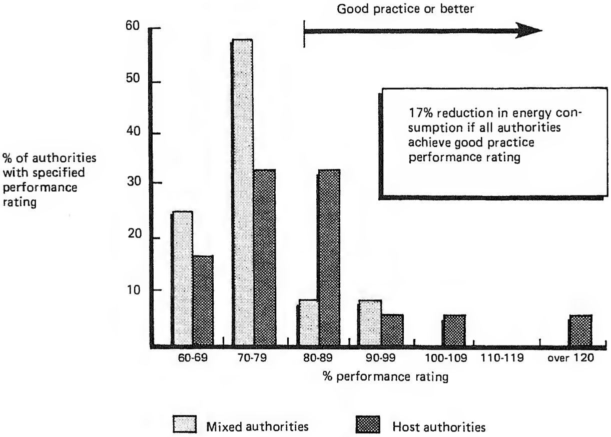
24. It is not correct to infer that authorities with an efficiency rating of 50% could halve their energy consumption in the near term because part of the explanation may lie in original poor design of their buildings which cannot now be fully corrected. However, a combination of good new designs, energy consciousness on the part of building users and appropriate installation of modern technical measures throughout an authority's buildings can eventually improve the efficiency of a poor authority by a factor of about two.

25. Exhibit 8 (page 18) shows the range in this authority performance rating for the 18 host authorities selected as being likely to be good authorities and the 12 audited authorities expected to be a mixture. Both groups comprise similar proportions of counties, metropolitan districts/ London boroughs and shire districts. In the 18 host authorities the rating varies from 62 to 156%, with almost half having a rating of 80% or better. In the 12 mixed authorities the range is from 62 to 94%, with fewer than one in five achieving a performance rating of better than 80%. Our recommendations on good practice in Chapter Two are based on the approaches adopted by the best of the host authorities, and Exhibit 8 confirms that these achieve the higher performance ratings.

Exhibit 8

DISTRIBUTION OF AUTHORITY PERFORMANCE RATINGS, SHOWN SEPARATELY FOR THE "HOST" AUTHORITIES AND THE "MIXED" AUTHORITIES

The host authorities have generally higher performance ratings than the mixed authorities



Source: Study team analysis of energy consumption in 30 authorities – 18 "host" authorities and 12 "mixed" authorities

26. Among the counties and metropolitan districts/London boroughs, the higher performance ratings are achieved by host authorities exhibiting all three of the following features:

- a central energy management unit comprising at least one person per £1 million energy spend;
- active in energy management for at least nine years;
- a cumulative investment in energy conservation uncorrected for inflation of greater than 30% of the FY 1984 energy budget.

Authorities exhibiting none of these features – all these come from the mixed group – have performance ratings averaging 14 percentage points less (67% compared with 81%). This study has shown that the key step to improving efficiency is to assign central responsibility for overseeing the authority's energy. It is essential that even small authorities recognise this and assign someone to this role, even if the size of the energy budget dictates that this should be part-time. The evidence of this and previous studies is that county councils have taken the most concerted action to improve their energy efficiency. This is because the magnitude of potential savings has made it easy to justify setting up central energy management units to develop a programme of investment in technical improvements. One county council in the study was employing ten people full-time in central energy management – a level of manpower investment that was justified by their £10m bill. In contrast, district councils with an energy bill of, say £400,000, have not always recognised the need to assign staff time to managing their energy (only a third of the shire districts in the study had a central officer or unit). Small authorities have also tended to not see their investment in energy efficiency measures as a single programme, but have required each application for capital finance to be vetted individually by council committees. Such a policy is a recipe for a stop-go approach. Because they have fewer buildings, district councils can more easily improve their energy efficiency, shown by the fact that a third of the districts had performance ratings above 90%.

27. The lower figure for improvement in Table 1 and Exhibit 3 assumes that all authorities raise their performance ratings to those of the current top 20% for their type of authority (i.e. a rating of 83% for counties and metropolitan districts and 100% for shire districts). The upper figure assumes that shire districts again achieve 100%, while other types of authority achieve 90%. In the long term, all authorities may be able to achieve 100% ratings but this may require the eventual replacement of much of the poor building stock.

28. Large increases in fuel prices in 1973–74 and 1979 stimulated many authorities into setting up programmes of energy efficiency improvements. Between 1978 and 1982 local education authorities received special financial allocations to improve their educational buildings and this stimulated effort. In recent years, financial stringencies have given added impetus, although capital constraints are widely claimed by authorities to have hindered their plans for investment in energy efficiency programmes. When capital is tight, members tend to favour investment schemes where the benefits are more visible than they are in energy conservation, e.g. sheltered accommodation for the elderly, where there is considerable demand. The working party which produced the recent Association of Metropolitan Authorities (AMA) report *Energy and Related Cost Savings in Local Authorities* commented on the following six factors:

(a) the wide range of opportunities for cost savings from energy conservation (typically, at least 10%);
(b) the corresponding range and diversity of existing advice and publicity;
(c) while comparing well with the commercial sector, only 36% of local authorities have implemented an energy management plan, 20% have carried out energy audits on some of their premises, and only 15% have a member committee with a brief including energy conservation;
(d) the minimal sharing of information and experience between local authorities, many of which are acting as guinea pigs on developments and equipment new to them;
(e) the perceived constraints on progress reported by some authorities;
(f) the absence of any co-ordinated local authority programme on energy savings.

29. The apparent scope for improvement in local government should not lead observers to conclude that authorities are more profligate with energy than other parts of the public sector, or than the private sector. For example, the Department of Energy's paper *Energy Conservation Investment in Industry*, HMSO, 1982, reports that the potential for further reductions in energy use among about 90 firms surveyed was 14% – almost exactly the same potential as appears to exist within local government. In individual cases the improvement potential ranged from zero to 50%, ignoring savings from schemes with paybacks greater than three years on the grounds that industry would regard such schemes as unattractive. The Department of Energy estimate that industry could achieve a saving of £300 million a year for an investment of a similar amount, and within a very short period of time could knock £1 billion off its energy bill. The Advisory Council on Energy Conservation comment that real progress in energy efficiency since the 1973 oil crisis has been "relatively poor", with the main

causes being sluggish growth, investment constraints and apathy.

30. It is not easy to make comparisons with the private sector in the case of many of the types of building owned by local authorities, because the compatibility of information from different sources cannot be guaranteed. However, a comparison with general – predominantly private sector – buildings is presented in Table 5 which suggests that the best of local authority buildings are on a par with the private sector but that the range in efficiency may be greater. However, too much should not be read into this comparison because of the problems of compatibility, although it is a similar picture to that which emerges from other studies carried out by the Commission, e.g. vehicle fleet management and refuse collection.

Table 5: ANNUAL ENERGY CONSUMPTION COMPARISON BETWEEN LOCAL AUTHORITIES' AND GENERAL BUILDINGS

	Best buildings		Fair to poor buildings	
	General	Councils	General	Councils
	kWh/m²/year			
Offices	200	200	250–350	300–400
Hotels/Residential homes	360	380	460–610	600–820
Factories/warehouses/depots	200	270	220–420	400–520

Source: 1985 special study; CIBS Building Energy Code Part 4, 1982; and information from the Department of Energy

* * *

31. This chapter has highlighted the importance of energy as offering a painless avenue for making substantial revenue savings. The room for improvement is indicated by the wide variation in the efficiency of individual buildings and of authorities' entire building stocks. Over a long period of time some authorities could reduce their energy consumption by a third and many can readily achieve savings of 20% or more. The next chapter describes the key features of energy management needed to achieve these improvements.

2. Key features of effective energy management

32. The key features of effective energy management can be summarised as in Exhibit 1 under the headings of the different but inter-related elements which combine to determine any organisation's effectiveness: vision, strategy, structure, skills/staffing and systems. In brief, they are:

(i) commitment from members, chief officers and building users;
(ii) sufficient financial investment in energy efficiency measures;
(iii) central manpower resources to control energy use, develop the investment programme and monitor progress;
(iv) the right climate to motivate spending departments and building users to become more energy conscious, including financial incentives, training and publicity;
(v) management systems to monitor and target energy consumption in the more important buildings and to ensure effective purchasing and tariff analysis of fuels.

Each of these aspects is discussed in detail below.

EVIDENT TOP MANAGEMENT COMMITMENT

33. One of the key conditions for effective energy management is that the members and chief officers of the authority should appreciate the benefits that can accrue when the energy resource is managed properly and that they should commit resources to achieving this objective. Put bluntly, the study suggests that if members make it clear that they are determined to see progress made, progress will result. But this determination needs to be more than skin-deep. The special study found that members invariably endorsed energy efficiency as a sound principle of good housekeeping; but only in some of the authorities did they take an interest in the programme of energy management. In times of capital constraint there was a tendency for members to give higher priority to more visible investments. There are instances of efficiency schemes with payback periods of less than two years being postponed in favour of a building scheme. Members tend to take a more active interest in conservation schemes for council houses – since here the benefits are more visible politically.

34. There are at least two ways in which members' and senior officers' commitment to improved energy management can be made more evident:

(i) preparing a comprehensive energy policy statement;
(ii) requesting an annual report.

Setting the policy

35. The best way of showing overall commitment is to produce a comprehensive energy policy statement. This shows people outside that the authority is committed to energy efficiency and, more importantly, it ensures a coherent and consistent approach within the authority.

The various headings that should be addressed in the energy policy statement are shown in Exhibit 9 below together with an illustration of typical policy statements. This could form part of an overall energy policy statement for the authority covering all aspects and uses: the second report of the Energy Conservation Panel of the Society of Local Authority Chief Executives, *Energy Conservation II*, summarises the topics that should be

Exhibit 9

COVERAGE AND ILLUSTRATIVE CONTENTS OF ENERGY POLICY STATEMENT

HEADING	ILLUSTRATIVE EXAMPLE (abbreviated)
Objective	'To reduce energy consumption by 20% within the next five years .....'
Strategy	
• Technical Improvements	'A programme of technical improvements to buildings and and plant will be implemented .....'
• Scheme Selection	'A simple payback of 3 years or less will be used to shortlist schemes .....'
• Capital Investment	'10% of the energy budget of each service department will be allocated each year to the programme of technical improvements .'
• Revenue Savings	'50% of the savings will be retained by the service department .....'
Organisation structure	'An energy management unit of three people within the Architects Department will be responsible for planning the programme of technical improvements and for monitoring and targetting .....'
Systems	
• Monitoring and Targetting	'The annual energy consumption and expenditure of each fuel for every building will be recorded centrally on the computer .....' Target energy consumptions will be established for all buildings with an energy budget exceeding £15,000 p.a.'
• Incentives	'Schools will be allowed to retain 50% of their savings over target to add to their capitation allowance .....'
• Training and Publicity	'The energy officer is responsible for training .....'
• Temperature	'Space temperatures in schools will accord with "standards for school premises regulations, 1973" Caretakers will be responsible for recording temperatures .....'
• Use of Buildings	'Proposals for the use of buildings outside normal hours (e.g. evening classes) will need to include an estimate of the extra cost of energy .....'
• New Build	'All new build proposals will include an estimate of the costs and savings from incorporating conservation measures additional to those required by the building regulations .....'
• Maintenance	'Repairs and maintenance work which affect energy consumption will be carried out within 14 days of notification .....'
• Purchasing	'All fuel will be purchased via the County Supplies Organisation. Tariff analysis will be performed annually ..... Computer tape billing will be introduced .....'

addressed in such an overall statement (and also gives an overview of energy conservation in general). Wherever possible, quantifiable targets should be set. For example, it is much better to state: "The intention is to reduce total energy consumption by X% over Y years whilst maintaining or improving levels of comfort", rather than: "The intention is to reduce total energy consumption". Newcastle initiated a six year programme with the stated objective of reducing consumption by 10% (a net recurring annual saving of £400,000 at 1981 prices). This was expected to cost £240,000 a year in capital expenditure.

36. Only three out of 30 authorities had a formal policy statement and these were all authorities with a performance rating within the top quarter of authorities studied. More commonly, members had generally endorsed energy efficiency as a "good housekeeping" measure which offered relatively painless savings. However, in the absence of a written statement conflicts arose, particularly over raising the finance for energy investment and how the resultant savings should be apportioned. As a result, progress was limited.

Annual report

37. One way of capturing members' interest, which also serves as an important internal discipline, is to present them with an annual report showing: savings achieved during the last year and cumulative savings achieved to date; progress in implementation of measures, with examples of savings achieved; and the investment required for the following year. The majority of counties, metropolitan districts and London boroughs studied presented an annual report, but few of the shire districts did so. Chief officers' commitment can be generated by presenting annual departmental summary reports and, particularly in the smaller authorities, by involving them in working parties overseeing the programme.

STRATEGY: INVESTING IN ENERGY EFFICIENCY

38. Money invested in energy efficiency measures is almost invariably money well spent. Many energy efficiency measures have paybacks of less than three years; in other words the original investment is repaid within three years. The savings, however, do not stop then but continue to accrue for the life of the particular measure. In addition, the value of the savings is linked to the price of fuel and is therefore effectively inflation-indexed.

39. The main requirement is for investment in technical measures, for example: improved control equipment such as optimum starts and automatic light switching; improved insulation and double glazing; installing low energy lighting tubes; zoning, so that not all the building needs to be heated if only part is in use; conversion of boilers (e.g. from oil to gas); installation of complete energy management control systems.

40. These technical measures and their benefits are quite well documented elsewhere (as the bibliography in Appendix A demonstrates). In particular, the CIPFA/SOLACE/LAMSAC *Value for Money Handbook* and TESCO/LAMSAC *1983 Team Awards* contain many examples of successful energy measures installed by local authorities, of which the following is but a small selection:

- recovery of heat from kitchen area of catering premises costing £40,000 and saving £12,000 a year;
- introduction of a heat pump and ancillary equipment to public swimming baths, costing £72,000 and saving £17,000 a year;
- replacement of oil-fired burners by gas-fired units in a swimming bath, costing £33,000 and saving an estimated £31,000 a year;
- application of a computer-controlled energy management system in a polytechnic, costing £130,000 and saving £73,000 a year. Similarly, one of the host authorities installed a computer-

controlled energy management system in 20 schools, resulting in savings of around 24% of energy and with payback periods for each school of between four and ten years;
- zone control of the heating system in a school, costing £4,500 and saving £3,500 a year.

It was not the purpose of this study to cover this well-trodden ground, but rather to assess how authorities should develop and finance a programme of improvements.

41. The investment programme needs to reflect local decisions on such matters as:

(i) where the money should come from; whether the programme should be funded centrally or by committees;
(ii) how much should be invested;
(iii) how projects should be selected;
(iv) in what order projects should be implemented.

Source of investment funds

42. One of the key decisions to make is whether investment finance should be provided from central sources or from the individual spending departments. The decision should be made on the grounds of effectiveness, taking into account the style of the authority and considerations such as who is allowed to benefit from the resultant savings.

43. *Centrally funded investment* is consistent with subsequent apportioning of the savings to the general rate fund, but it may divorce the spending departments from the investment programme. Where central funding/central retention of savings has been adopted there have tended to be disputes between the spending departments and the treasurer's department over the level of savings actually achieved. However, central funding can ensure a coherent approach across the authority. For instance, Essex adopted central funding for energy measures and building maintenance after finding that departmental performance in investing in schemes advised by their architects department was patchy: some departments were implementing all such schemes while others (such as social services) as few as one scheme in eight proposed. [This is in line with the findings of the 1982 LAMSAC study which also cited social services committees as having a poor record of investing in energy conservation, despite their having buildings with relatively high consumption per unit of floor area.]

44. *Investment funded by spending committees* tends to be favoured by smaller authorities with an energy budget of less than £1 million. However, this is often on an *ad hoc* basis, with the committee considering every item of expenditure individually rather than approving a year's programme of work. This reduces stability and makes long-term planning more difficult.

45. One useful concept is that of a self-financing efficiency fund, in which a proportion of revenue savings are channelled into a fund to finance further investment in energy efficiency measures. Cambridgeshire is one of the few authorities which operates a fund formally in this manner, but a number follow the concept informally, e.g. Dorset. In both of these authorities the estimated savings in any one year have exceeded the necessary investment, except in the very first year, and therefore the programme has been effectively self-financing. Unfortunately, inflation means that fuel bills often continue to rise despite the reduction in actual consumption of fuel. This complicates the running of an efficiency fund since it requires a calculation of what the expenditure would have been had there been no investment and it can be difficult to convince people of the validity of the calculation.

46. Normally, investment in energy efficiency measures is treated as capital expenditure. However, a number of authorities treat items of

expenditure below a certain level as revenue; others finance significant expenditure from maintenance monies; and Dorset treats all energy efficiency investment as revenue expenditure, in line with its treatment of capital expenditure generally. Maintenance monies are often used to enhance energy efficiency when, for example, an old boiler is replaced with a more efficient modern boiler or insulation is included when a roof is re-laid.

47. A recent development is the provision of capital and expertise by an energy service company, which then shares in the savings achieved. The EEO has recently published *Guidelines for Local Authority Shared Savings Energy Performance Contracts**. Energy performance contracting is the generic name for all kinds of contracts for the purchase of energy-saving equipment and services which are set up in such a way that the building owner or customer pays for the improvements over a period of years out of the resulting savings. Under a shared savings contract, the contractor, using his own financial resources or in association with an investor, finances and undertakes energy-saving feasibility studies and the design and installation of new energy efficiency equipment in the customer's premises. The contractor owns the improvements either throughout their life or just for the duration of the contract, generally in the range five to ten years if a substantial investment is being made. He plays a direct role in the operation and maintenance of the new equipment either using his own staff or sub-contractors or training and overseeing the customer's staff. At the end of the contract the new equipment may be transferred into the ownership of the customer for a consideration defined in the contract or without consideration; or the contract may be re-negotiated or the customer may enter into a hire agreement at nominal charge to cover the remaining life of the equipment.

48. The contractor's reimbursement is based on a calculation of the gross savings during the period of the contract, being the difference between the updated base year costs and the contractor's actual costs (excluding capital recovery and interest charges). The updated base year costs are the costs which would have been incurred if the new equipment had not been installed and are a projection of the base year costs into the future taking into account fuel price rises, changes in building use patterns, climatic variations, etc. The sharing of savings between customer and contractor may be based on these gross savings (e.g. 35% to the customer, 65% to the contractor) or on some more elaborate calculation of the net savings.

Scale of investment

49. The amount of money that *should* be invested in energy efficiency measures depends upon: the condition and current energy efficiency of the non-domestic building stock; the cost effective improvement opportunities that have been identified; and the amount of work that can be sensibly controlled by the authority's officers and handled by contractors. The amount that *can* be invested depends, of course, upon the competing calls for capital and revenue funding and local decisions on overall investment priorities (though access to shared-savings contracts should reduce the number of authorities pleading shortage of capital).

50. The recommendation emerging from this study is that a minimum of 10% of the energy budget should be invested in energy efficiency measures. A higher level of investment than this will also nearly always be cost effective. The range of investment varies considerably between authorities.

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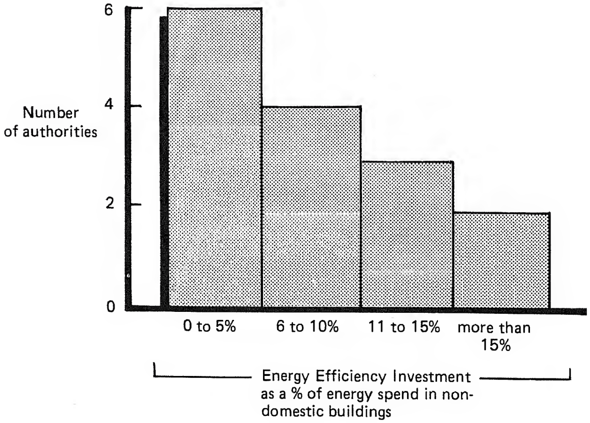
* Available from Room 1312, Energy Efficiency Office, Thames House South, Millbank, London SW1P 4QJ

Exhibit 10

ENERGY EFFICIENCY INVESTMENT IN THE HOST AUTHORITIES



Source: Special Study team analysis, 1985, of data from 15 host authorities

The investment made by the host authorities as a percentage of their energy spend is shown in Exhibit 10 above. For example, two of the host authorities invested annually more than 15% of their energy spend in energy efficiency measures while six invested less than 5%. On average, the host authorities with a track record of improving their energy efficiency invested annually around 10% of their annual energy spend. This level of investment over, say, five years should achieve savings in energy costs of the order of 20% per annum.

51. The build-up in investment can be gradual. For example, after five years of their programme, Dorset reckoned to be saving nearly 20% of their energy bill. The build-up of their programme is shown in Table 6.

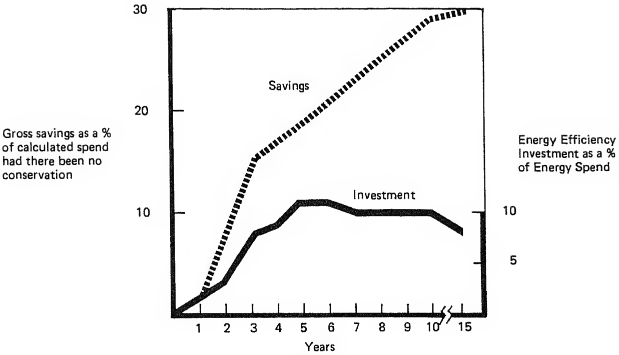
Table 6: BUILD UP IN ENERGY INVESTMENT IN DORSET

% of energy budget invested	FY1978	1979	1980	1981	1982
	2.0%	4.0	8.3	9.1	10.9

Initially, while an authority is still gaining experience, the financial investment tends to be limited by the rate at which opportunities are identified. Very quickly the list of opportunities outstrips the funding available and the financial investment tends to be limited by the other non-energy efficiency requirements for funds and the amount of work that can be sensibly controlled and handled by the authority. After about ten years of investment, at the 10% plus level, some authorities are finding that the most obvious opportunities have been implemented and investment tends to plateau out at a slightly reduced level. Exhibit 11 shows a graphical representation of a typical energy investment programme. It can be seen that provided the build-up is gradual it is feasible to fund each year's investment from the savings made from the previous year, except possibly in the very first year.

Exhibit 11

ILLUSTRATIVE PHASING OF ENERGY EFFICIENCY INVESTMENT, AND RESULTANT SAVINGS



Source: Savings estimates are based on host authorities' experiences projected to 15 years, and include savings from good housekeeping measures

52. Several authorities (for example, Essex and Leicester City) find it useful to provide a separate revenue budget to cover items of an indirect energy-saving nature, such as: test equipment for monitoring the performance of boilers, measuring temperatures, trials of new equipment to evaluate their performance; energy surveys of buildings; and publicity and training material. As a rule of thumb, it is worth setting aside £5,000 per £1 million energy spend for revenue items of this nature.

Project selection

53. The method of appraisal used to select energy efficiency measures in almost all authorities is simple payback. This is the simplest method of appraisal involving a calculation of the time required to recover the initial capital outlay, i.e. how long it will take for the investment to pay for itself. It is calculated as the ratio of the capital cost to annual savings achieved at current fuel costs. For example, if the conversion of an oil-fired burner to a gas-fired boiler would result in annual savings of £800 at current fuel prices and would cost £2,400 to implement, then payback is three years [2,400 ÷ 800].

54. The payback period approach commends itself for its simplicity of calculation and interpretation and is the method recommended for presentation to members and for drawing up an investment programme. However, it has certain disadvantages, e.g. it ignores the timing of cash flows and it ignores the life and residual value of the assets. It is worth emphasising that the savings from energy-efficiency measures will be achieved in every year in the future and not just for the duration of the payback period. If fuel prices increase/decrease, the value of the savings will increase/decrease; and thus the savings are effectively inflation-linked.

55. For deciding which payback periods represent worthwhile investments, it is preferable to use the internal rate of return method of project

appraisal. Internal rate of return is a discounted cash flow method of investment appraisal which acknowledges the importance of timing, i.e. that funds invested in the future have less impact than funds invested now and that savings received early in a project should be valued more than savings received later. Appendix D relates internal rates of return to payback period and discusses which payback periods represent worthwhile investments. Energy efficiency projects with paybacks of more than about six years need to be examined critically to ensure that they have a long enough life to warrant diverting investment money from other opportunities elsewhere within the authority. Exhibit 12 shows the typical paybacks from common energy efficiency measures. The periods are only illustrative, and vary for each building depending upon the existing systems, desired conditions and occupancy patterns; they relate to the particular measures being carried out individually. Costs will be reduced and therefore paybacks shortened if the work is undertaken as part of a larger refurbishment programme.

Exhibit 12

TYPICAL PAYBACK PERIODS FOR DIFFERENT MEASURES

PAYBACK (years)	MEASURE
Less than 3 years	Draughtproofing. Replacement of tungsten bulbs with miniature fluorescents. Installation of the following controls: . thermostats . time clocks . optimisers . compensators Loft insulation. Zoning of heating systems to facilitate various patterns of use within properties. Rationalisation of hot water service to reduce storage and circulation losses.
3 – 6	Oil to gas conversion of boiler plant. Decentralisation of boiler plant. Installation of high efficiency lights. Pipework changes to improve the efficiency of heating systems. Cavity wall insulation. Thermostatic radiator valves installed separately. Reducing excessive glazing by the addition of insulating panels.
6 or more	Draught lobbies. Integral flat roof insulation. Double glazing. Waste heat recovery from exhaust air.

Source: Energy Efficiency Office

56. Maximum payback periods can be stipulated as a way of identifying the worthwhile projects. Thus, in the early years of a programme, a maximum period of, say, two years can be demanded. In the middle years of a programme, five years can be used as the criterion. The range of maximum paybacks permitted in the host authorities is shown in Table 7. Although the upper limit is generally five to six years many of the measures being implemented have paybacks of two to three years and less; and indeed many authorities, even after a number of years of energy efficiency investment, are still identifying and implementing measures with these short paybacks. For example, Newcastle City are still averaging two to three year paybacks on the whole investment programme even though they have been active in energy management for some considerable time. They changed the payback filters as the programme built up, e.g. in the first year the filter was 18 months, in the second year the filter was two years, and so on.

Table 7: MAXIMUM PERMITTED PAYBACKS
15 HOST AUTHORITIES

Maximum payback allowed	Number of authorities applying
6 years	1
5 years	6
4 years	3
3 years	3
2 years	2
Less than 2 years	0

Sequence of investment

57. An approach to drawing up a long-term programme of improvements is discussed in Chapter Three. Until now, the major choice facing authorities was between a *horizontal* or *vertical* approach.

58. In the *horizontal* approach a single type of energy efficiency measure is implemented across a range of buildings. For example, an authority may convert all boilers throughout the authority from oil to gas. In a subsequent phase all boilers may have improved time controls fitted. The horizontal approach is more appropriate in the larger authorities with a large number of buildings of similar category, where it is feasible to install fabric insulation or certain controls in groups of, say, 50 buildings at a time. In the *vertical* approach, a number of buildings are identified and in each one all the practicable measures are implemented more or less on one occasion (e.g. cavity insulation, draught stripping, boiler conversion, time controls, re-roofing, etc). The smaller authorities with only a few significant energy-using buildings tend to adopt a more vertical approach identifying all the opportunities in particular buildings and implementing as many as possible at one occasion.

59. Essex adopts a shopping-list approach to certain types of energy efficiency measures so that contributions can be readily authorised and linked into the maintenance programmes. The central energy management unit manages a very large investment programme amounting to £2 million per annum. There are five full-time Area Officers who visit the buildings and decide on the implementation of individual measures up to £2,000 in value.

60. The major reservation about authorities' past approaches to devising an investment programme is that they have not been sufficiently discriminating, particularly the large authorities. In all authorities the approach should be to identify the buildings with the largest potential for saving –

these will be the buildings with a relatively large energy expenditure and/or poor energy efficiency. Schemes should then be ranked and implemented according to their paybacks.

61. In the case of new build the opportunity exists at the design stage to incorporate energy efficiency measures which for minimal, if any, extra cost reduce the running expenses of the new building dramatically. For example, some, if not all, of the following features should be considered when designing a new leisure centre complex with wet facilities: full insulation of roof, walls and floors; heat pumps; pool covers; advanced humidity control systems; zoning of heating and cooling systems; heat recovery; high efficiency lighting and electronic building management systems*. The Dolphin leisure centre in Darlington has a Normalised Performance Indicator of 422 kWh/m^2/annum, dramatically below the efficiency yardstick of 900 kWh/m^2/annum, and reflecting what can be achieved by good design. Similar opportunities for installing technical measures present themselves with maintenance programmes; when a flat roof is being replaced it is cost effective to incorporate insulation in the new roof; when a boiler is being replaced it is cost effective to upgrade the controls at the same time. A number of authorities permit part of the revenue maintenance budget to be spent on such "piggyback" measures.

STRUCTURE: SUITABLY STAFFED CENTRAL EFFORT

62. The appointment of an energy officer or the establishment of an energy unit is a visible first step towards energy efficiency and acts as a focal point for the authority's programme. The study found that the number of people involved in the management of energy and the management structure varies considerably between authorities. The main distinction in management structure is between the authorities with an annual energy spend of more than £750,000 (primarily metropolitan districts, large shire districts and county councils) and the smaller authorities, primarily districts in rural areas. The larger energy-spending authorities tend to adopt a formal approach with a central energy management unit of several people. This unit is staffed by people with energy/building, services-related skills. The smaller energy-spend authorities, with possibly as few as four or five significant energy-using buildings, tend to adopt an informal approach with an energy officer (who may be part or full-time) aided by the line managers of the main energy-user departments.

63. The effort put into the central management of energy expressed in staff-years is shown in Exhibit 13 opposite plotted against the energy spend of each host authority. The authorities spending more than £3 million a year benefit from economy of scale and devote about 1.1 staff-years per £1 million spend. The authorities spending less than £1.5 million a year allocate 1.6 staff-years per £1 million energy spend. On this basis, the effort devoted centrally to the management of energy should be about one staff year per £1 million expenditure on energy in the non-domestic buildings. A higher level than this can be beneficial, particularly in the smaller authorities.

Single policy-making body

64. In all sizes of authority the most coherent approach to the management of energy occurs where one of the existing committees takes overall responsibility for energy-efficiency measures, determining energy policy and requiring that the policy is put into effect. In most authorities this is the policy and resources committee or equivalent. In some of the larger authorities the committee responsible for all building and land use matters

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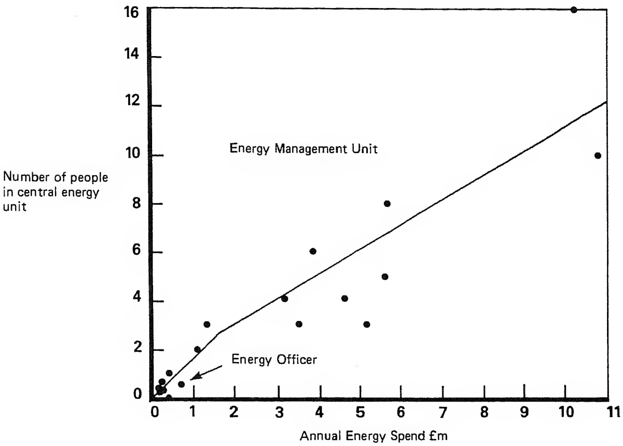
* The Sports Council's Technical Unit offers advice on useful energy-saving measures in the design of leisure centres.

is also responsible for energy efficiency in the authority's non-domestic buildings.

Exhibit 13

MANPOWER INVESTMENT IN THE HOST AUTHORITIES

The effort devoted centrally to the management of energy is about 1 man per £1m energy spend, more in the smaller authorities



Source: Information from 18 host authorities, FY 1984

Central energy management unit

65. The key role of the energy management unit in a large authority is to monitor energy consumption and expenditure centrally, as this information is the platform for effective energy management. In the majority of cases, the energy management unit is also responsible for the investigation of deviations in energy consumption when they occur, and for advice on the management of the energy efficiency investment programme.

66. The most suitable position for the unit is, therefore, within the department most closely involved with the non-housing building stock. For example, this could be: architects, technical services, engineers, construction services, or land and buildings. The special study found that whether new building designs were energy efficient or not depended on how energy conscious the architects department was. The location of the energy management unit can have some influence on this, as well as on the degree of integration between maintenance measures and energy efficiency measures. A survey conducted by the Association for the Conservation of Energy, *Energy Saving and Local Authorities,* showed that the most popular locations for the energy unit were technical/building services, architects and engineers.

67. Wherever the unit is located, it is important that links are forged with: the finance department – to ensure co-operation in the transfer of invoice data and so that it can audit the claims for savings and manage the energy investment accounts; with the architects department – to ensure that new buildings and alterations are designed with energy efficiency in mind; with the maintenance section – to ensure that requests for remedial work are actioned quickly; and last, but not least, with the building users. For

example, South Glamorgan issue an action works order to the maintenance department when repair work is required to stop energy being wasted.

68. It is desirable that the unit leader should report directly to the head of department to ensure that energy management receives sufficient attention. The head of the unit needs to be someone who gets on well with the spending departments and building users because part of the unit's function is to motivate them to be more energy conscious and to offer them advice.

69. The *Energy Manager's Workbook* (Energy Publications, 1982) lists five qualities required of an energy manager: good communicator, good administrator, enthusiastic, broad-minded and with the ability to understand people. The job of energy officer must be given to someone who is keen and gets on well with the users – it must not be seen as an undemanding job that can be given to just about anyone. A keen and active energy officer, even if part-time, can make all the difference to an authority's energy efficiency because of the gearing effect if his enthusiasm is imparted to the building users and spending departments. In the smaller authorities, a detailed technical knowledge of energy matters is not a prerequisite.

70. Many smaller authorities are concerned by their lack of technical expertise in identifying opportunities for the installation of energy efficiency measures. The basic recording and monitoring function of the energy officer does not require detailed technical knowledge to highlight the high, energy-using buildings. Once this has been done, specialist services can, if necessary, be bought in from consultants and larger authorities. Energy surveys carried out by both of these groups are eligible for EEO grants, as EEO booklet *Schemes and Services for Local Authorities* describes.

71. In a small authority the role of an energy management unit can be fulfilled by a working party of officers from the main energy-using departments supported by an energy officer (full or part-time depending on the energy budget). The primary role of the energy officer in the smaller authorities is to record and monitor energy consumption and cost centrally, acting as the focal point for the relatively informal management structure. Energy officers are found in: finance, technical services, management services and chief executive's departments.

72. The energy officer acts as the provider of energy information to a working party of line managers from the main energy-using departments. This working party formulates and organises the approach to the installation of energy efficiency measures. Proposals for investment would be prepared by the working party for submission to the appropriate funding committee. The involvement of departmental line managers in this way is extremely beneficial in that it minimises the officer-time spent on energy management, makes use of the detailed knowledge of the officers and ensures feedback of information to the user departments and individual building users. For example, each member of the energy management working party of Rhymney Valley takes responsibility for a particular group of buildings to ensure the vital link with the building users. A working party approach makes the most effective use of officer-time and ensures their commitment. The working party should meet no more frequently than monthly and no less frequently than quarterly. New Forest have a working party of seven officers including representatives from the main energy-using departments (health, housing and leisure services), the planning department, the central services (treasurer's and district secretary's departments) and the technical department which provides the lead.

73. Allerdale District Council has an annual energy spend of about

£200,000 on its non-housing buildings and devotes about 0.25 staff-years per annum to central monitoring of energy consumption. Users are kept informed on an exception basis, i.e. if their consumption deviates by more than 10% from that in the corresponding period last year. In Darlington, with an energy spend of £650,000 both energy consumption and cost data are recorded, monitored and targeted centrally by the architects department, which, with assistance from management services performs most of the functions listed earlier for an energy management unit.

Functions of energy management unit

74. The main functions of the energy management unit in a large authority should be to monitor current energy consumption, advise on the programme of technical measures and encourage users to be more energy conscious. Specifically, the study suggests the following functions are appropriate to the unit:

(a) Collection and analysis of energy consumption and cost data to assist in developing realistic energy targets for buildings and setting energy-spend budgets.

(b) Tariff analysis (the 1985 AMA report *Energy and Related Cost Savings in Local Authorities* recommends water assessments should also be included).

(c) Monitoring energy-consumption against targets to detect deviations in consumption, investigate the causes and initiate corrective action.

(d) Highlighting the large energy-consuming buildings and the buildings using more than the norm for that particular category of building. Dorset analyse the energy expenditure for their schools to produce performance indicators showing the buildings costing the most per square metre. Brent produce annual performance indicators (of the form kWh/m^2/annum) to highlight buildings using above the norm for that category.

(e) Organising surveys of buildings to identify suitable measures to improve the energy efficiency of the authority's buildings. Essex have carried out some 1,400 individual building surveys.

(f) Developing and managing an investment programme of energy efficiency measures. Co-ordination of energy efficiency measures with maintenance and new build programmes is especially important. Cheshire estimate that design and administration costs account for 25% of the total cost of individually installed energy efficiency schemes; with a co-ordinated scheme the proportion drops by over one-third to 15%.

(g) Training building users in the correct operation of plant and good housekeeping techniques. Many authorities hold training sessions for caretakers and officers-in-charge, particularly when new equipment is installed. For example, Stockport produce comprehensive user manuals detailing exactly how heating plants should be operated for maximum efficiency.

(h) Disseminating energy performance information to user departments and building users. Leicester City produce an annual energy performance report for all the major energy-consuming buildings.

(i) Calculating overall improvements achieved, to enable an annual progress report to be submitted to committee.

STYLE: CREATING THE RIGHT CLIMATE

75. Very roughly, half the available savings opportunities fall into the category of good housekeeping and they require thousands of people across local government to think and act with a little more care to reduce waste. Such a change in attitude will not be easy to secure. The experience of the

successful host authorities suggests that specific steps must be taken to create the right climate, involving: generating commitment from members and chief officers and involvement from employees; providing the right incentives and overcoming financial and organisational barriers to efficiency. Each of these is discussed further below.

Generating commitment and involvement

76. The importance of gaining the commitment of members and chief officers to the energy management effort has been discussed earlier. Gaining involvement from employees requires a programme of publicity and training. There is a tendency for members in particular to regard expenditure on publicity and training as superfluous partly because of the difficulty of quantifying the benefits. However, such an attitude overlooks the major contribution building users and staff can make to energy efficiency, particularly by way of good housekeeping measures such as switching off lights when rooms are not in use, turning the heat down rather than opening windows to cool a room and the restrained use of electricity for lighting and portable heaters, etc.

77. The contribution that users can make to greater energy efficiency should not, therefore, be underestimated. Anecdotal and other evidence suggests that savings from good housekeeping by building users can equal in magnitude savings from the technical measures – and cost considerably less to implement. For example, a survey conducted by the Property Services Agency estimated that over the period 1972 to 1983 energy savings in government buildings of around 44% had been achieved, with one-third resulting from capital investment measures and two-thirds through improvements in good housekeeping. Local authorities frequently find that savings achieved after the installation of technical measures exceed the theoretical estimate, largely because the building users have also been stimulated to better housekeeping.

78. Yet during the fieldwork for the study, many anecdotes were recounted to us of faulty time switches and boiler controls going undetected for anything up to one year, and of further delays of up to a year occurring before the fault was remedied. So it would be unwise to assume that commitment to saving energy is universal within local government. One authority corrected their previously poor maintenance record by introducing a priority system which attempted to repair any faults incurring additional energy cost within a maximum of two weeks.

79. The key requirements for generating commitment and involvement are:

(a) programmes of publicity to raise and maintain people's energy awareness, highlighting the savings already achieved;

(b) training plant operators and building users in the most efficient ways of operating a building and its various energy-consuming systems;

(c) encouraging on-site reading of meters and tank contents gauges, with the information fed through to an energy officer/energy management unit. For example, in South Glamorgan's schools a great deal of work was put into installing oil-flow meters to all burners, labelling all types of meters with a code and teaching caretakers to read meters. A series of meetings was organised and each caretaker was issued with an accurate thermometer and a wallet of instructions;

(d) encouraging on-site monitoring of energy consumption against target to detect deviations more quickly and increase the users' energy awareness and involvement, as in Leicester City;

(e) organising remedial action to correct deviations in consumption. For example, a time switch may become defective allowing plant to run for 24 hours a day, causing increased energy consumption. This time switch should be replaced as soon as possible.

80. Some examples of how authorities achieve this are:

- Coventry has departmental energy representatives in education and social services to ensure close involvement with the users in these two major energy-using departments.
- Essex issues an eye-catching broadsheet *Energy Matters* to keep everyone in the authority informed.
- Cambridgeshire is producing electricity performance indicators for individual building establishments to monitor against, as this is one form of energy over which the users have a lot of control.
- Oxford operates a staff suggestion scheme in which effective energy-saving suggestions result in a financial reward to the proposer.

Providing incentives

81. There are four key parties involved in energy efficiency and the motivation of each needs to be considered: the authority as a whole; the spending department/committee; the establishment running the building (e.g school); and the caretakers and occupants who affect energy consumption in individual buildings. Authorities should have an explicit policy as to which of these parties are allowed to benefit from energy savings. This policy should distinguish between savings resulting from technical measures (e.g. insulation) and those resulting from good housekeeping measures.

82. Many authorities find it difficult to motivate the building establishments and occupants to conserve energy unless they can see some benefit. This has given rise to local financial management initiatives. It may be pertinent that all but one of the authorities permitting establishments to retain savings due to good housekeeping had performance ratings in the top half of authorities.

83. It would seem appropriate that building establishments should be permitted to use energy savings from good housekeeping measures to spend on other items. Similarly, spending committees should be allowed discretion over part of the savings from technical measures if they financed the investment originally. For example:

- In Cambridgeshire, schools are given responsibility for part of their budget and are allowed to vire between one budget head and another. Thus, savings in energy are, for example, available to be spent on more school text books.
- In Newcastle, 30% of the savings achieved in schools are added to the capitation allowance of the schools – in future the scheme will be limited to electricity usage only, as the building users have much greater influence over electricity consumption than over fuels used for space heating. Cheshire and Coventry have similar schemes.
- South Glamorgan has gone further than most authorities and operates a financial incentive scheme for school caretakers. Caretakers are paid five hours' overtime per week for the 26 weeks of winter to read meters weekly and pay attention to energy efficiency. The county reckons to have saved four times the cost of the scheme since it began in 1980-81. As might be expected, the additional savings level off after a number of years as the more obvious good housekeeping measures are implemented. The scheme appears, therefore, more appropriate as a start-up scheme.
- Cheshire allowed retention of 50% of the savings by departments

for an initial period of two years to increase energy awareness and involvement.

84. The Society of Chief Architects in Local Authorities (SCALA) has reviewed local authority energy-saving incentive schemes in its *Occasional Paper No 40*. The great majority of existing county incentive schemes are based on the recycling of part of the energy savings made by schools to the schools' capitation allowance. Incentive schemes for non-educational premises are in their infancy and suffer from the problem of identifying acceptable recipients or causes to make repayments to. The SCALA paper refers to school incentive schemes based on enhanced capitation allowances run by Berkshire, Buckinghamshire, Derbyshire, Nottinghamshire and Warwickshire. Derbyshire's scheme is one of the longest running. Each school is given an annual target, based on an average of its historic consumption over the three years preceding the start of the scheme, corrected for weather, technical measures, changes in use and adjusted to take account of whether the school was previously profligate or frugal in its use of energy. The gross savings attributable to the scheme in the first six years have been about £800,000, of which some £440,000 has been returned to schools. The initial setting of targets and promotion of the scheme occupied one person for four months in the first year, and for one to two months in subsequent years.

85. The SCALA paper concluded that incentive schemes based on repayments to users for achieving consumption targets can be a very cost-effective way of making major energy savings, but listed a number of key requirements: setting and maintaining fair targets, while recognising that absolute fairness is unobtainable; the need for adequate discussion and promotion; and the need for a computer programme if more than about 50 premises are covered. The SCALA paper also commended caretaker bonus-incentive schemes for consideration, particularly for non-educational buildings where it is difficult to find effective ways of repaying savings to users.

Overcoming barriers

86. The two most important barriers to overcome are rigidities in the system of management accounts and the lack of positive incentives to service committees.

87. In the accounts of many authorities fuel is subsumed under the heading "fuel, light and cleaning materials" in accordance with CIPFA accounting guidelines. It cannot, therefore, be identified separately. The study team visited many authorites that had given no thought to the way their budgetary systems may have affected spending committees' attitudes to energy efficiency investment – this comment applies particularly to the shire districts. Indeed, some treasurers were unable to refer to any defined policy for setting the energy budgets for individual departments or spending committees and were unable to say whether they took account of energy efficiency measures recently installed. It emerged that most budgets were set by increasing last year's actual expenditure by an allowance for anticipated inflation. The procedure for budget setting is important and is discussed below.

88. The commitment of the service committees to investing in energy efficiency measures is very closely bound up with the pressure on them to reduce expenditure and the question of who benefits from the revenue savings. In many authorities the savings are returned to the general rate fund which reduces the incentive to the service committee to invest, as they are not allowed to retain the savings. Some authorities – but none of the shire districts in the study – allow retention of part of the revenue savings by user departments and/or building establishments to act as a positive

incentive to contribute to the overall effort.

89. To enable this type of incentive to operate successfully, accurate and reasonable energy-spend budgets must be set for individual departments and/or cost centres. There should also be a mechanism for allowing for exceptionally cold winters when normal budgets may be exceeded, and in the case of departmental budgets, changes in building stock need to be taken into account. If there is a central allocation of funds for energy efficiency investment, savings are usually recouped centrally by reducing the department/cost centre budget. However, the users can increase the savings further through good housekeeping. These additional savings could be retained by the department or cost centre as a positive incentive to encourage the users' involvement. For example:

- the method of reducing energy-spend budgets to take into account energy efficiency investment is kept simple by Cheshire, which reduces departmental budgets by one-fifth of the capital cost of the measure irrespective of the predicted payback – which would always be less than five years, so the cut in departmental budgets will be less than the actual savings achieved;
- Essex calculates energy-spend budgets assuming normal weather conditions with a contingency fund for extremely severe winter weather.

MANAGEMENT SYSTEMS

90. The final key to an effective energy management programme is sound management systems to: monitor energy consumption and cost in individual buildings; to provide senior management with appropriate reports; to allow energy targets to be set for individual buildings and services; and to ensure that energy prices are as low as they could be. Each of the systems is described in more detail in the balance of this chapter.

Monitoring consumption

91. A comprehensive management information system, often referred to as a monitoring and targeting (M&T) system, is required to assist in identifying inefficient buildings and deviations in consumption; to check fuel invoices; and to keep the members and the users informed of performance. It involves the systematic, regular recording of the energy consumption of all fuels, together with their costs, for each building. This need not be prohibitively expensive. Stockport estimates the cost of its weekly recording of heating fuel consumption and monthly recording of electricity to be £40 per building per annum. Such a cost may be partially covered by the errors in fuel invoices that it will highlight.

92. The study found that some authorities failed to record consumption data from the invoices at the same time as the expenditure data – consumption data is needed to monitor energy use because energy costs vary over time. The study showed that too many authorities paid invoices without fully verifying their accuracy or reasonableness. In contrast, in Rhymney Valley individual energy invoices are received by each building and are forwarded to the finance department accompanied by copies of weekly meter-reading forms for the period of the invoice.

93. Authorities should adopt a selective approach to the buildings included, and to the data collected and analysed:

- the annual energy consumption and expenditure of each fuel for every building should be recorded from the fuel invoices and maintained centrally under a building reference;
- consumption should be recorded more frequently (monthly) for the top 20% of energy-consuming buildings*, either from the fuel

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*Typically, 20% of the buildings by number account for about 70% of the energy consumption of the stock as a whole.

invoices or from on-site meter readings, or a combination of the two. In Darlington, ten out of 25 significant buildings account for over half of the energy spend and in these top ten buildings the energy consumption is recorded on-site monthly by the building users and then sent to the architects department for central analysis;

- in some larger energy-using buildings, such as leisure centres, consumption may be recorded daily or weekly on-site by the building users. However, this information should be transferred to the central M & T system monthly.

94. The host authorities were equally divided between those basing their energy consumption on invoices and those reading meters. No clear better option emerged. Several large authorities told of the problems experienced in obtaining regular, accurate meter returns from building users: as many as one-third of the readings can be in error. The authorities with a smaller number of buildings to manage experienced less problems. This would indicate that a selective approach, where meters are read in the top 20% of buildings, keeps the number of buildings and the amount of data to manageable proportions.

95. Meters are usually read monthly by the staff on site. Richmond appoints an energy representative in each building, one of whose primary roles is to record and monitor energy consumption by reading meters and forwarding the information at monthly intervals to the energy management unit. In some circumstances, staff from the energy management unit or maintenance department can be used to read meters but those occasions should be minimal and effort should instead be devoted to training and motivating the building staff to read meters regularly.

96. Problems can be encountered with bulk-delivery fuels, such as coal, when opening and closing stocks must be estimated to enable consumption to be calculated. SCALA *Occasional Paper No 39* recommends that solid fuel and oil stock figures be checked against deliveries and payments quarterly, and that the method of monitoring should be a comparison with target and the average of the two previous years' consumption. Some authorities have fitted flow meters to large oil tanks to assist regular monitoring.

97. The benefits of central analysis of the data by the energy management unit or the energy officer are obvious. However, it can still be useful in the large energy buildings (e.g. swimming pools) for the users to monitor and plot their own consumption to detect deviations more quickly and to increase the users' energy awareness.

98. Monitoring energy consumption is one area of energy management where districts appear to be better organised than counties – probably because of the ease of handling the smaller number of buildings they operate. The value of central monitoring for all authorities is corroborated by the finding that the counties in the top half of the performance ratings were those adopting the above procedures.

99. The new developments in computer systems should make it easier for large authorities to employ central monitoring. Increasing use is being made of micro-computers for the storage and analysis of energy consumption and cost data and this trend should be encouraged. This makes it possible to handle considerable volumes of data in a timely manner and to provide exception reports, which is difficult to accomplish manually. One host authority attempts to collate and analyse data on 120 of its 300 buildings manually; but it takes from March until the autumn of each year, with the result that an inefficient building could go undetected for 18 months.

100. Manual card systems should be limited to situations where only a

small number of buildings (less than 50) are being monitored. Mainframe systems, in the larger authorities, tend to be based in the finance departments and often do not allow data manipulation in the ways required for effective energy management.

101. Under the auspices of the Department of Energy, LAMSAC have produced a monitoring and targeting system specifically for local authorities. This is being made available to local authorities for a small cost including implementation advice. There are three types of system:

- Level 1: manual (card index) and suitable for up to 50 buildings.
- Level 2: computer-based and suitable for up to 300 buildings.
- Level 3: computer-based, suitable for up to 1,500 buildings, with enhanced storage capacity. The level 3 system has an enhanced emphasis on exception reporting. For example, ranked data may be obtained for kWh/m^2, £/m^2,kWh/capita and £/capita to focus attention on the rogue buildings.

102. Authorities can determine which system best suits their needs and fits in with existing management practice. An executive workbook provided by LAMSAC offers advice on this. Analysis for calculating targets within the systems is based on regression analysis of past consumption against degree-day data. Initially, if insufficient data is available, the system will operate on a comparative performance index (kWh/m^2) basis with only one year's data. M & T systems are also marketed by, among others, PA and Stark Associates.

103. Computer tape billing by the utilities for the larger authorities is to be encouraged to reduce the processing costs of paying the bills, and to facilitate provision of management information in a convenient form. These advantages should generally outweigh the cash flow disbenefit of paying faster, but this needs to be assessed locally. The *Audit Guide to Cash Flow Management* discusses this area further.

Analysis and reporting

104. The main purpose of the M & T system is to maintain and improve the energy efficiency of the authority's buildings, not merely record and report historic facts. The management information produced from the analysis of the cost and consumption data should:

(a) detect deviations in consumption away from target so that remedial action can be taken and errors in invoices detected;
(b) highlight the buildings using the most energy (i.e. the top 20% by number) so that effort can be concentrated on these buildings to improve their energy efficiency;
(c) highlight buildings with the maximum potential for improvement by comparison with national yardstick performance indicators.

The data should also be analysed at building and authority level to monitor progress towards greater energy efficiency.

105. *At building level*, where measures have been installed or good housekeeping programmes have been initiated, actual savings should be calculated on an annual basis to verify that predicted savings and paybacks are being achieved and to enable more accurate prediction of savings in the future. This is essential for at least a sample of schemes to ensure that the claims for technical measures are not overstated (the reverse is usually the case because building users are aroused by the attention given to the building to make further savings from good housekeeping). However, it has to be recognised that the energy management unit in a large authority has a vested interest in promoting technical schemes and is not immune from making optimistic claims.

106. *At authority level*, the energy expenditure and consumption of the whole non-domestic building stock should be collated so that overall

savings, corrected for weather variations and changes in the building stock, can be calculated. Again, it must be recognised that the energy management unit has a vested interest in showing its efforts in the best light. In the study, one unit had conveniently failed to correct for building stock changes, and had omitted the correction for weather variations in years when it would have reduced the apparent savings. In another authority, the unit had failed to correct for building stock changes despite the fact that the correction would have increased the calculated savings! Thus, the annual report on energy savings should be audited by another department within the authority, such as the treasurers.

107. An annual *Energy Management Progress Report* should be submitted to the policy-making committee covering the points discussed above. It is also useful to produce individual building and department annual summary reports showing the quantities and cost of energy used and the percentage change compared to previous years. This helps to maintain the interest and energy awareness of the various line managers involved and of the building users themselves.

Targeting

108. Targeting complements monitoring: it requires the setting of target annual energy consumption for individual buildings and is usually related to some form of incentive scheme. An energy target is essentially a management tool to encourage improved efficiency. Targets for each fuel are usually based on the previous year's consumption, or a certain percentage below, to motivate users to adopt good housekeeping measures.

109. Target setting for individual buildings is fraught with difficulties. If targets are set relating to a previous year's consumption then buildings which had previously been profligate in energy will find it easy to achieve the targets. Many authorities experienced in energy management are trying to overcome this objection by setting targets based on theoretical calculations and/or a detailed survey of each building. However, at the current state of the art theoretical calculations are difficult to relate to actual energy consumption, and it is necessary to apply "calibration factors", i.e. multipliers which vary for each building. For running incentive schemes, targets need to be attainable in the short-term and therefore the yardstick Normalised Performance Indicators (NPIs) tabulated in Chapter One are not immediately applicable (it is for this reason that the term yardstick rather than target was used to describe them). As Chapter One demonstrates, it is unrealistic to expect all buildings to achieve these yardstick NPIs without some capital investment in technical measures. However, the yardstick NPIs will indicate the overall scope for improvement in a building. Whichever method is used for calculating targets, it needs to take into account the effect of energy-efficiency measures installed and the same factors that are allowed for in calculating NPIs, such as weather variations (see Appendix C and the Chartered Institute of Building Services' Guide, *CIBS Building Energy Code, Part Four)*. Several authorities have experience of the development and application of targets:

- Cambridgeshire have developed targets for electricity consumption for schools to enable them to monitor their performance. The consumption depends on whether the school is primary or secondary, the size of the establishment (assessed by counting the number of teaching areas) and the amount of community use (i.e. none, some, extensive). [Extensive community use increases electricity consumption by about 77% compared with no community use]. The Cambridgeshire pack and computer programme can be purchased from the authority.

- Eleven secondary schools in Cheshire are participating in a pilot scheme in which targets are being set for each fuel based on the average consumption for the two previous years adjusted for weather and energy efficiency measures installed. This pilot scheme allows virement of all the savings achieved to other expenditure items. An attempt was made to calculate targets on a theoretical basis, but this was abandoned in favour of targets based on historical performance.
- In Coventry, targets are based on historical data, adjusted for weather and hours of use. One-third of the savings against target accrue to the individual establishment to use as it thinks fit.
- Essex sets financial targets for each building based on the previous three years, and when deviations are detected by the central energy unit local investigations are initiated.
- Leicester has selected representative buildings from each department, 22 in total, and produced graphs showing target fuel consumption based on the previous year's less 10%. If it is noted that consumption has increased by more than 10%, the appropriate department is notified.
- Richmond monitors consumption against targets based upon previous consumption, adjusted to take into account energy-efficiency measures installed. A pilot schemes is on operation in nine secondary schools where savings due to good housekeeping are retained in full by the establishment. Problems have been experienced in setting and agreeing realistic targets and in differentiating between savings due to the installation of technical measures and those due to good housekeeping.
- South Glamorgan is developing targets based on the past two years' consumptions of heating fuel, presented in graphical form for completion locally by each school.

Effective fuel purchasing and tariff analysis

110. Electricity is charged at an almost bewildering number of tariffs: general purpose or block tariffs, maximum demand tariffs and time of day tariffs. Periodically each building should be checked to ensure that electricity is being supplied at the tariff that minimises annual expenditure. For example, Dorset changed 24 tariffs in 1982–83 yielding a saving of £12,000 per annum. Leicester City reckon to have made savings of £290,000 over four years on electricity tariff changes (but only £78,000 over the same period on gas tariffs – with gas the tariff structure is much simpler).

111. The requirement for fuel tariff analysis appears to be well appreciated by authorities. Nearly all the authorities regularly reviewed their fuel tariffs even if that was the only energy management procedure they undertook. Many of them had entered into contracts with fuel tariff consultants, in which the consultants regularly reviewed the authority's tariffs and advised on changes. Despite the fact that the consultants retain up to 50% of the savings for themselves, many of the authorities were sufficiently attracted by the administrative convenience of the arrangement to renew the contracts when they came up for review. Other authorities, particularly the larger ones, have preferred to assign this role of tariff analysis to a central energy management unit or officer. Savings from tariff analysis are tangible and many energy officers have found that it is an effective way of establishing their credibility within the authority. The utilities will be prepared to advise on choice of tariff, and many have a computerised tariff analysis service based on the last twelve months' billed consumption. Authorities appear not to have availed themselves of this service much, but could do so as an alternative to consultants or at least as a first step.

112. The importance of effective heating oil purchasing was highlighted in the Commission's report *Reducing the Cost of Local Government Purchases – A Progress Review,* HMSO, 1984. This suggested that nationally local authorities may be able to achieve savings of £10 million by using their bulk-purchasing power to negotiate better prices for fuel. Authorities also need to be alert to possible short deliveries, particularly of oil and solid fuel, and false invoicing. It is not unknown for coke to be sprayed with water to increase its weight, or for oil tankers to have an empty compartment into which the oil is delivered rather than into the authority's oil tank – the oil will still be registered on the meter as having been delivered. Instances of 10% or more of the coal ordered not arriving on the lorry or being driven away after the delivery were also cited to the study team.

113. The relative costs of different fuels should be kept under constant review. Many authorities have changed boilers from oil-firing to gas because of the cost advantages. Coal is quite competitive; but authorities may be uncertain about the long-term supply and price stability, and therefore reluctant to commit the capital finance needed for the conversion or upgrade of the existing plant. A recent development which may be attractive to authorities wishing to convert to coal is a scheme for providing a mobile boiler financed by a private sector organisation. This is connected to the existing pipework in a matter of a few days and the heat sold to the authority on a metered basis. No capital costs are incurred by the authority and no long-term commitment is required. Savings of the order of 20% are claimed for many such installations, some of which are being monitored as Energy Demonstration Projects. Savings arise from the use of up-to-date, properly insulated and maintained boilers and from bulk purchasing

Exhibit 14

TYPICAL ANNUAL SAVINGS FROM BETTER ENERGY MANAGEMENT

TYPE OF AUTHORITY	COUNTY COUNCIL	METROPOLITAN DISTRICT/LONDON BOROUGH	NON METROPOLITAN DISTRICT
Typical annual energy spend on non-domestic buildings	£6.6m	£4.0m	£0.45m
Typical potential for gross saving	£1.1m	£0.7m	£90,000

This saving could be used to	Cater for a 35% increase in the number of home helps		Provide community centres

Source: Study team analysis of potential for improvement in 30 authorities, FY 1984, and experience in the 18 host authorities discounts for the fuel; and, of course, the local authority does not need to invest scarce capital in upgrading or replacing its boilers.

114. This is not the only way in which partnerships with the private sector can pay dividends. Contracts with heat service companies are quite popular – one of the largest firms in this field has contracts with over 90 local authority departments for either maintenance or full heat service. Under a heat service contract a company takes responsibility for the operation and maintenance of the plant including repairs and replacement thus offering an opportunity to contract-out some aspects of energy management. Under a single tariff contract, the price is fixed (subject to an inflation clause) for heating or cooling a building to a specified temperature for a specified period of the year, irrespective of prevailing weather conditions.

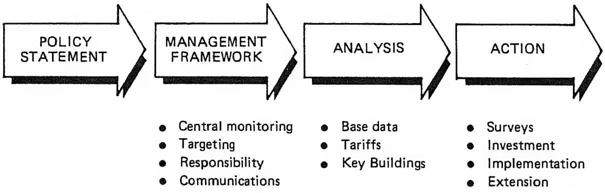
115. This chapter has highlighted the key features of energy management. Exhibit 14 opposite shows the order of magnitude of savings that are feasible in an average authority in the near term. In some authorities the potential savings will exceed these figures quite significantly. Even in an authority which has been active for a number of years, the potential for further saving is likely to be around 10% of the annual energy spend. The next chapter summarises the steps needed to ensure that action is taken to make the necessary improvement.

3 Making improvements

116. This present chapter sets out an action programme which can be followed by any authority. Authorities which have already taken the first steps will nevertheless find it valuable to adopt the structured approach to developing a programme of technical improvements as set out here, and summarised in Exhibit 15.

Exhibit 15

ENERGY CONSERVATION APPROACH



For an authority which has not yet come to grips with energy management the two key steps are:

(i) launching the effort by establishing a policy and setting up the appropriate organisational framework and systems;

(ii) developing a phased programme of technical improvements to buildings and plant.

This Chapter discusses each of these steps in turn.

LAUNCHING THE EFFORT

117. The catalyst to action should be the formulation of a written policy statement by the council covering the points itemised in Exhibit 9. This will ensure a coherent rather than piecemeal approach. The next steps should be:

- to appoint an energy officer or establish an energy management unit to act as the focal point for the authority's programme. The number of people involved centrally should be about one person for every £1 million spent on energy in the non-domestic building stock, although proportionally higher resources can be justified in the smaller authorities;
- to undertake analyses of tariffs to identify the cheapest tariffs. Tariff analysis can ensure early wins for the new organisation and therefore is an effective way of establishing credibility;
- to install a monitoring and targeting system, which is a fundamental requirement of controlling and then reducing

energy consumption, and provides the basis for developing the programme of technical improvements.

118. With these steps completed, the effort needs to be broadened to promote energy awareness. The point was made earlier in Chapter Two that the major contribution that building users can make to greater efficiency should not be overlooked. Too many authorities devote most of their attention to the technical solutions and do not recognise the benefits from relatively inexpensive programmes of training and encouraging energy awareness. The payback on such programmes can be a matter of weeks rather than years; but the effect does not endure very long unless it is constantly reinforced.

119. Target consumptions for buildings are an important way of raising the energy awareness of building users provided they are communicated widely and appropriate incentives are in place for users. Formal monitoring and targeting should be instituted in all the major buildings – the top 30 to 40 buildings, to begin with, in large authorities to keep the number manageable; or the highest consuming 20% in small authorities where the number of buildings involved is in any case small.

120. At an early opportunity a report should be prepared for the council highlighting the achievements to date and setting out a phased programme of technical improvements to buildings and plant, together with a bid for long-term funding of the programme.

DEVELOPING AN INVESTMENT PROGRAMME

121. The investment programme itself requires the following steps. First, the high energy-using buildings need to be identified. Then energy surveys of the selected buildings need to be carried out. Finally, an integrated programme should be drawn up. Each step is discussed below.

Focusing the effort

122. A small proportion of buildings account for a large proportion of the total energy expenditure. Table 8 below shows, for example, that 20% of the buildings typically account for 45 to 70% of the energy consumed.

Table 8: BREAKDOWN OF ENERGY EXPENDITURE

5% of buildings	account for	25–45% of energy consumed
20%	account for	45–70%
40%	account for	55–80%

123. The initial focus of any investment programme should, therefore, be on the 20% of the buildings with the highest energy consumption. These can be identified by ranking all the authority's buildings in order of decreasing consumption, excluding buildings with an annual energy cost below £1,000. For this purpose energy cost can be used as a proxy for energy consumption and is likely to be more readily available. The top 20% of buildings can then be identified. For a small district, the number of such buildings is likely to be around 25, for larger districts including metropolitan districts and London boroughs it will typically be between 75 and 150 and for county councils it will be between 150 and 300 buildings.

124. For each of these selected buildings, the following information should be assembled:

- name and address of building, type of building and site exposure;
- total floor area;
- hours of use per annum;
- annual consumption of each fuel, for heating, lighting and other uses;
- annual expenditure on each fuel.

This is the minimum information required to calculate the Normalised Performance Indicator (NPI), which was introduced as a concept in Chapter One. The necessary calculations are described in full in the companion audit guide, and summarised in Appendix C. The result of the calculation of the NPI for each building is an energy consumption expressed as kWh per square metre of floorspace per annum, adjusted to normal building exposure, average weather and average hours of use for that type of building.

125. Having calculated NPIs for the highest consuming 20% of buildings, the range in NPIs can be presented graphically and the authority performance rating can be calculated. This calculation will normally be performed by the auditor as part of the value for money audit in the round commencing November 1985. Appendix E shows part of the standard report that many auditors will be adopting. This presents the performance rating and lists the buildings with poor NPIs. The authority performance rating will give an indication of the overall scope for improvement in efficiency. For example, if the performance rating is around 100% this indicates that the authority's building stock contains mostly buildings which are among the best quarter nationally (although as Exhibit 8 on page 18 showed, that still leaves scope for improvement). If the performance rating is below 50% considerable scope for improvement exists – indeed over a long period of time the consumption of energy could probably be halved. Authority performance ratings are only approximate as a way of comparing one authority's scope for improvement against another because they do not take into account the structure and design of the buildings. But the ratings are extremely robust as a way of measuring the change in efficiency of an authority's building stock over time and thus could form an integral part of an annual report to council.

126. Histograms, such as those displayed in Appendix E, can be used to identify the buildings apparently most warranting attention. Two points should be noted:

(a) in a minority of buildings all the feasible energy-efficiency measures may have been installed but the NPI is high either because of poor original design or because of some valid, but exceptional, use of energy in the building; initially these buildings will be wrongly classified as having scope for improvement, but this will be corrected later (e.g. once a survey has been undertaken) and hence can be tolerated in the analysis;

(b) the procedure above will not identify the buildings where a change of fuel would be beneficial and such opportunities should be assessed separately.

127. Each of the selected buildings should be placed on a graph equivalent to that shown in Exhibit 16 opposite which is an example from one of the 30 authorities in the study. On this graph, each building is located on the vertical axis according to its annual energy expenditure and on the horizontal axis according to the ratio of its NPI to the yardstick NPI for that category of building (see Table 4). For example, building number 40 – a secondary school – has an annual expenditure close to £60,000 p.a. and an NPI about twice the yardstick. If its consumption could be reduced to the category yardstick the annual saving would be about 50% or £30,000 p.a. This is obviously a building which warrants early attention. Building number 20 – a primary school – is more inefficient since its NPI is about 3.6 times the category yardstick, and the potential for savings is therefore 72%*. However, since its annual expenditure is only about £10,000 the

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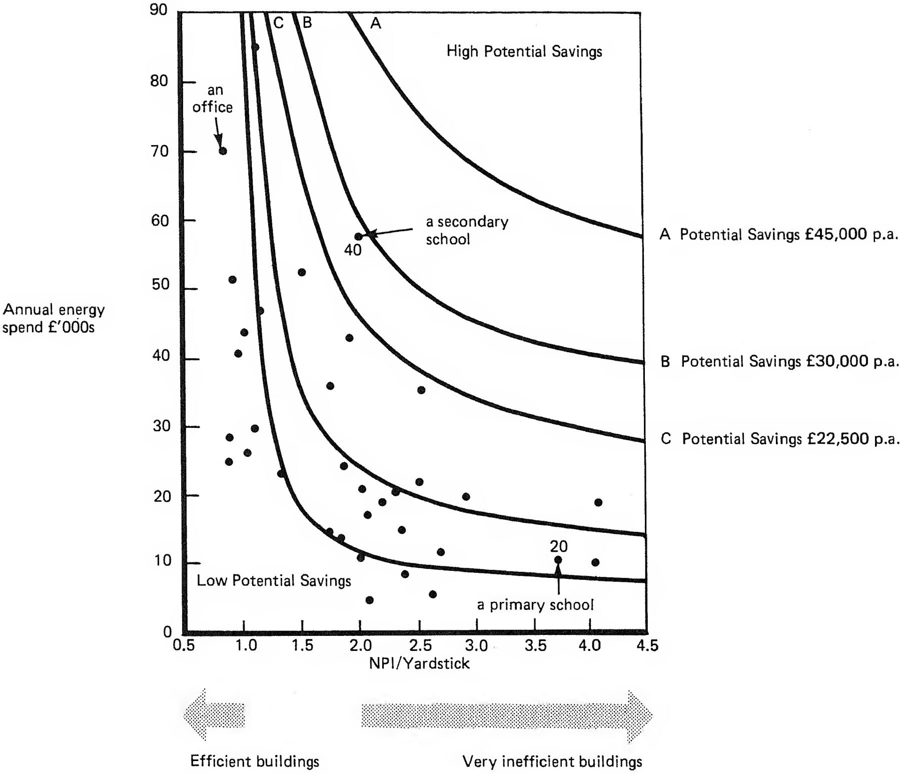
*3.6 (current) – 1.0 (target) = potential improvement; potential improvement ÷ current performance = 2.6 ÷ 3.6, which is 72%.

Exhibit 16

ENERGY SPEND AND EFFICIENCY IN INDIVIDUAL BUILDINGS IN AN ILLUSTRATIVE AUTHORITY



Source: Auditor's analysis of an authority's data, 1985

potential savings will amount to £7,200, which is less than for building number 40. The lines drawn on Exhibit 16 serve to identify the buildings with savings potential of a certain amount. Thus, all the buildings above the line BB have a potential for saving more than £30,000 p.a. – only building 40 comes near this. Buildings on or above the line CC but below the line BB have a potential for saving between £22,500 and £30,000, and so on.

128. Even large authorities will find it difficult to concentrate on more than 30 to 50 buildings initially, and in a small district council with a part-time energy officer the initial focus of attention is likely to be on no more than five or six buildings. Although the procedure described above can form the backbone of the approach to identifying the initial phase of buildings warranting attention, other considerations may influence the selection. For example, South Glamorgan decided to concentrate on

educational buildings initially, since these dominated the authority's energy expenditure, and it was administratively more convenient to liaise with one (co-operative) service department. Such an approach will also have the most impact because the savings in the chosen service department's energy expenditure will be more marked than if the programme is dissipated across many service departments' buildings. In addition, a programme of technical measures can be integrated with a programme of targeting and/or financial incentives. Partly for these reasons – and because the yardsticks for the above procedure were not available at the time – most of the host authorities chose to focus initially on the buildings operated by one or two departments.

Carrying out energy surveys

129. The next step is to organise energy surveys of the selected buildings. Under the Energy Efficiency Survey Scheme run by the EEO, grants of up to 50% (subject to a maximum of £250) are available for short energy surveys by consultants; and grants of up to 50% (maximum £10,000) are available for more detailed and comprehensive surveys. Under the new scheme there is no longer an official list of consultants and it is up to the applicant to choose an appropriate consultant; the choice can be the staff of another local authority. Alternatively the authority can choose to forego grants and use its own staff. Some authorities are able to successfully harness feedback information from the maintenance department to assist in the energy surveys of their buildings.

130. The aim of each survey is to identify specific measures which can reduce energy consumption in the particular building. These should be categorised as either no, low or high cost and the actual cost and payback determined:

- no cost measures cover good housekeeping such as turning off unnecessary lights and dealing with steam leaks, repairing faults requiring minimal expenditure or only maintenance money;
- low cost measures cover items such as plant and pipework lagging and draught-stripping;
- high cost measures include capital investment in more energy-efficient plant and heat-recovery equipment, etc.

No cost measures can be implemented almost immediately by liaising with the building staff or the maintenance department. An important consideration in estimating costs is to take into account when the work is to be undertaken, e.g. whether as a special contract, as part of a general programme of similar improvements in other buildings, or as part of repair or refurbishment work to be undertaken simultaneously.

131. The experience of one authority illustrates the scope of the various measures that can be taken to improve energy efficiency in individual buildings:

(a) The main administration centre for the County (photograph opposite) and one of the County's largest buildings with a floor area of 17,000m^2. Over a period of five years the energy efficiency of the building has been steadily improved by the following means:

- cavity wall insulation at a cost of approximately £10,000;
- flat roof areas insulated during re-roofing;
- draught seals incorporated when windows were replaced;
- new high-efficiency boilers installed when plant became due for replacement – cost approximately £145,000 for complete installation;
- electronic energy management system installed to provide better control of the plant and heating system;
- library and clinic (attached to County Hall) provided with their

(a)

own boilers and heating system;
- direct gas-fired unit installed to provide hot water requirements;
- thermostatic radiator valves installed on the south side, with coverage gradually being extended;
- power-factor correction equipment installed.

As a result of these measures the NPI for the building has been reduced from 245 kWh/m^2/annum in FY1980 to 141 kWh/m^2/annum in FY1985. It is, therefore, now well below the efficiency yardstick of 230 kWh/m^2/annum for its category. Nevertheless, further improvements are planned, including: draught lobbies, high-efficiency lighting to be installed when the building is next re-wired (in the near future) and improvement of the computer room air-conditioning.

(b)

(b) A small special school with a hydrotherapy pool in a very exposed location. Since 1980 the energy efficiency of the school has been improved by the following means:
- improved method of pool-water treatment has been installed enabling ventilation rates to be reduced;

- pool cover installed to reduce heat and evaporation loss from the pool overnight;
- simplified control panel installed in the boiler house enabling the caretaker to control the heating system more easily;
- variable-speed fans fitted to the warm air heaters in the class rooms to give better control;
- glazed area reduced by fitting insulated panels;
- draught-stripping and insulation of roof lights.

As a result of these measures the NPI has been reduced from 577 kWh/m^2/annum in FY1980 to 245 kWh/m^2/annum in FY1985. This is still somewhat above the efficiency yardstick for its category, although this may be partly explained by the hydrotherapy pool.

The council calculates that, compared with consumption in 1979–80, it is saving over £50,000 a year in energy costs in these two buildings alone.

Drawing up the programme

132. The low and high cost measures need to be put into a pool of schemes, from which a phased programme may be constructed and finance made available. The pool of schemes should be drawn up as in Exhibit 17, with schemes ranked according to payback. A graphical representation is also valuable. The authority can then select appropriate schemes either by applying a payback filter (e.g. all schemes with paybacks of less than two years) or by imposing a financial ceiling (e.g. all schemes for which the cumulative cost is £50,000). These considerations were discussed in Chapter Two.

133. Having decided on the schemes to be implemented, they should be presented in the *Annual Report* to the council as the next year of the long-term programme of improvements. In subsequent years the programme is extended to incorporate buildings with smaller potential savings than those in the first phase (see Exhibit 16), and more buildings should be trawled so that up to 90% of the energy expenditure is included in the net.

134. Perhaps inevitably, the above approach will seem somewhat theoretical. However, many authorities have successfully applied its principles, with very worthwhile results. Appendix E provides a case example for one such authority, Dorset. This County administers a population of approximately 600,000 in some 1,024 square miles. In the 1983–84 financial year gross expenditure on services was in the order of £232 million. This is administered by seven spending committees which control some 2,000 buildings on 600 major sites, with a total energy bill of £3.68 million in 1983–84.

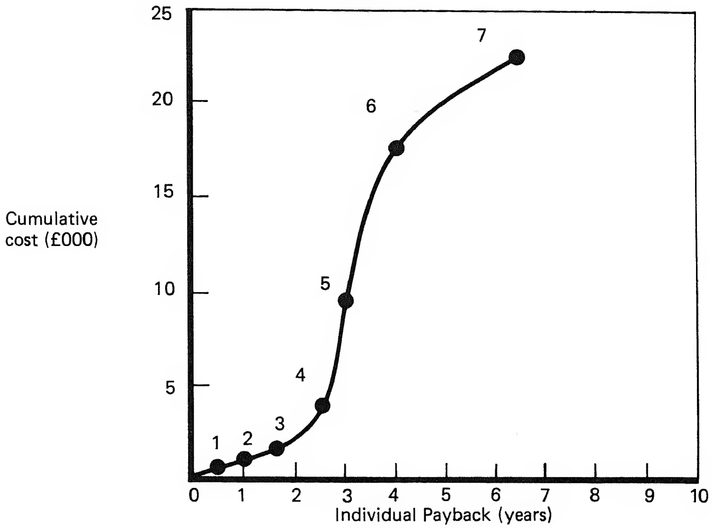
135. The County has been actively involved in the management of energy since 1975, when fuel tariffs were first analysed and it was demonstrated that financial savings could be achieved. An Energy Conservation Team was formed within the County Architect's Department to act as the focal point for all energy-related matters. A gradual approach to energy-efficiency investment was adopted, with the savings achieved used to fund further investment. After ten years, a constant level of investment has been reached (£350,000); and savings worth over £1 million a year are being achieved.

136. The Architect's Department is responsible for all aspects of the County's non-housing building stock and co-ordinates capital projects, maintenance and energy-efficiency works. The Department is organised on a multi-professional project basis which ensures the efficient use of resources to identify and organise the implementation of energy-efficiency measures. The approach can be characterised as follows:

- structured, step-by-step approach;
- realisation right from the start that a database of property and

Exhibit 17

ILLUSTRATIVE ENERGY INVESTMENT PROGRAMME



MEASURE NO.	DESCRIPTION OF MEASURE	COST	SAVING
1	Improved control equipment	400	800
2	Improved insulation	500	500
3	Install low energy lighting tubes	500	300
4	Install thermostatic radiator valves during refurbishment in April 1986	2000	800
5	Replace oil-fired burner	6000	2000
6	Install energy management system	8000	2000
7	Construct draught lobbies	5000	800

energy consumption information is the foundation of effective energy management;

- appreciation that savings need to be assessed, audited and reported and forward plans for investment proposed to committee, to ensure that there is continuing commitment of resources to energy management within the authority;
- professional energy management unit of three people within the County Architect's Department with excellent links to the various departments such as Treasurers, Education and Social Services;
- a comprehensive approach to improving the energy efficiency of particular buildings by considering not only the building fabric and plant options but also the good housekeeping aspects.

137. This systematic approach is reflected in the milestones in Dorset's ten year programme to date:

1975 Tariff checking.
Implementing no cost measures such as adjusting controls.
Monitoring results by manually checking fuel bills.
Starting to demonstrate that worthwhile savings could be made.
1977 Fuel Efficiency Officer appointed.
Improvements made to heating system controls, roof insulation, etc.
Foundations laid for computerised property register.
1978 Senior Energy Conservation Engineer appointed to head Energy Team.
Property/energy database created using the County's main frame computer.
Consumption comparisons started.
Start of major energy-efficiency investment programme with a central revenue budget provision of £187,000 for 1978–79.
1979 Educating building users in good housekeeping techniques.
1980 Continuing programme of energy-efficiency measures, e.g. cavity-wall insulation, flat-roof insultation, oil to gas conversions, improved controls.
1982 Computer-tape billing of electricity accounts implemented.
Energy Team extended to three full-time staff.
1983 Extensive work carried out on school sports centres and swimming pools, i.e. pool covers, heat recovery, efficient lighting.
1984 Micro-computer link created between the County's mainframe computer and the energy management unit to enable data to be extracted easily and analysed.
1985 Financial incentive scheme proposed to encourage the positive involvement of the building users.

138. Since the start of the energy-efficiency investment programme in 1978–79 the savings achieved have been impressive: £3.9 million cumulative savings over six years for an investment of £1.8 million over the same period. Current annual savings are running at the rate of £1 million per annum (1983–84). Exhibit 5 showed the details.

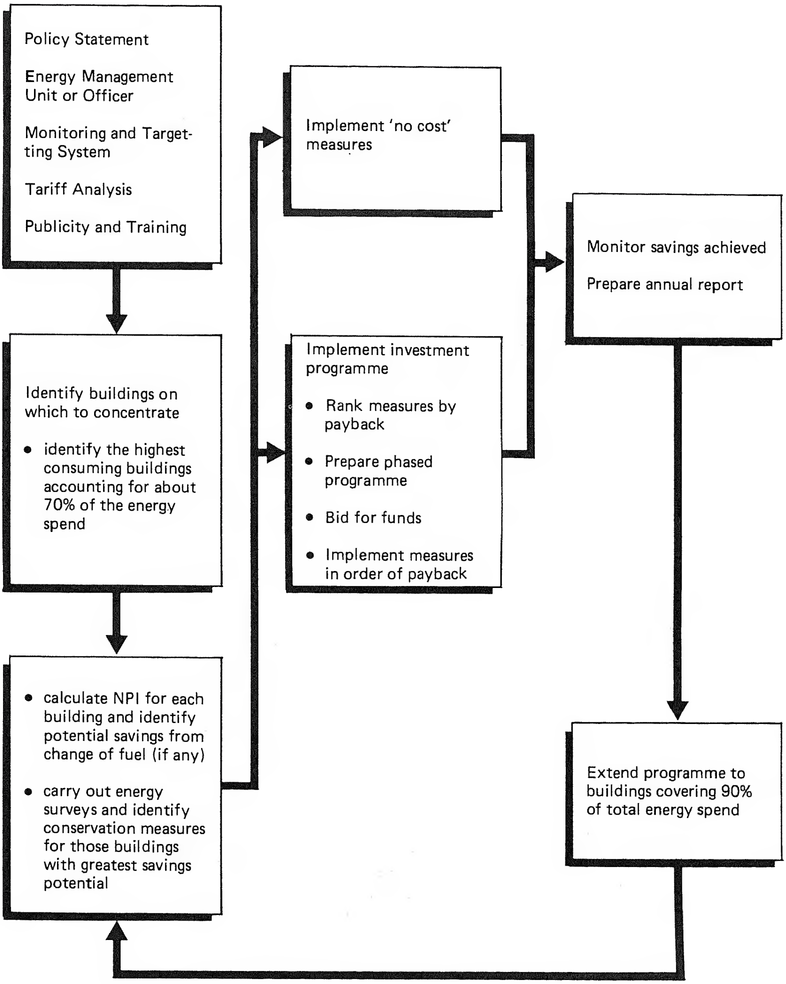
* * *

139. Dorset is not an isolated example; as this report has demonstrated many of the host authorities have implemented all, or elements of, the approach proposed. And many other local authorities, not studied in this effort, have achieved worthwhile energy savings by taking some (if not all) of the steps recommended in this report and summarised opposite, in Exhibit 18. With the necessary capital investment, will to manage and

commitment from members and officers, substantial savings – worth well in excess of £100 million a year – can be achieved quite quickly. This programme can even be self-financing to a very large extent. The Commission hopes that this report, and the value for money projects that will follow in the majority of authorities, will help ensure that these savings are achieved.

Exhibit 18

MAKING IMPROVEMENTS


Policy Statement
Energy Management Unit or Officer
Monitoring and Targetting System
Tariff Analysis
Publicity and Training
Identify buildings on which to concentrate
• identify the highest consuming buildings accounting for about 70% of the energy spend
• calculate NPI for each building and identify potential savings from change of fuel (if any)
• carry out energy surveys and identify conservation measures for those buildings with greatest savings potential
Implement 'no cost' measures
Implement investment programme
• Rank measures by payback
• Prepare phased programme
• Bid for funds
• Implement measures in order of payback
Monitor savings achieved
Prepare annual report
Extend programme to buildings covering 90% of total energy spend

Glossary

The following terms are used in this report:

Authority Performance Rating:	A measure of the energy efficiency of the authority's building stock as a whole (see Appendix C). The synonymous term "authority energy efficiency rating" is used in the audit guide.
Degree Day:	Degree day figures represent a record of the extent and length of time that the outside temperature falls below 15.5°C. One degree day is a period of 24 hours during which the *average* outside temperature is 1°C below 15.5°C.
Delivered Energy:	The heat content of fuels purchased by the final consumers. This is always less than the primary energy owing to conversion and distribution losses.
Efficiency Yardstick:	The NPI achieved by about the best quarter of buildings nationally in each category.
Energy Management Systems:	A phrase often used to mean electronic energy/building management systems that control energy-consuming services within a building from a central computer.
Exposure:	A measure of the effect that the particular location of a building has on its energy consumption. An exposed building will tend to consume more energy than an equivalent sheltered building.
Good Housekeeping:	The users of buildings play an important role in controlling energy and by good housekeeping can significantly reduce energy wastage. This term would cover simple measures such as remembering to switch off lights and close doors.
Horizontal Investment Approach:	The implementation of a single type of energy efficiency measure (e.g. optimisers) across a range of buildings.
Hours of Use:	The number of hours during which the building is used. This generally corresponds to the number of hours that the building is occupied by people working or having business there. Times when only cleaners or maintenance staff are there alone are not counted.
Host Authority:	One of the 18 authorities selected in the expectation of being among the more efficient authorities nationally, and reviewed in depth by the special study team. Appendix B lists the host authorities.

Internal Rate of Return:	A discounted cash flow method of investment appraisal (see Apendix D).
kWh:	Abbreviation for kilowatt-hour, the normal unit for the measurement of electricity.
M & T System:	Monitoring and targeting system. This is a management information system, often computer-based, and designed to record and generate reports on the energy consumption in buildings.
Management of Energy:	The overall management of the energy resource to ensure that energy is used efficiently, thereby reducing cost.
Mixed Authority:	One of the 12 authorities reviewed by auditors and expected to be a fairly representative mixture of authorities.
Monitoring:	The procedure of recording energy consumption at regular intervals and comparing this to a target consumption for a building.
Normalised Performance Indicator (NPI):	The annual energy consumption expressed in kWh per square metre of floorspace, adjusted to national average hours of use, normal exposure and average weather (see Appendix C).
Payback:	Simple payback is the time taken for the capital cost of an investment to be recouped from the return on the investment.
Target:	A specified reduced level of energy consumption which it is aimed to achieve in a building as a result of improving efficiency but which takes into acount the hours of use and size of a building together with variations in the weather. Used to determine the extent to which improved efficiency has been achieved.
Tariff Analysis:	Usually applied to electricity. There are many different rates (tariffs) at which electricity is charged, and it is worthwhile periodically checking that each building or supply point is being charged at the rate that minimises the total annual cost. Tariff analysis does not in itself save energy – only money.
Useful Energy:	The quantity of energy measured at the point of use. This is less than the delivered energy owing to conversion and distribution losses within the building.
Vertical Investment Approach:	The implementation of a range of energy-efficiency measures in one building.

Appendices

To provide as comprehensive a report as is required to meet the (differing) needs of members and officers within local authorities, the following appendices are included:

A – *Bibliography*. Much very useful work in the field of energy management has been done in local government in recent years. SOLACE, CIPFA and LAMSAC in particular have made major contributions. This appendix therefore lists documents that provide useful background reading.

B – *Authorities participating in the Special Study*. Although a total of over 30 authorities were examined in detail, 18 participated in the original Special Study. These are listed, so that others can contact them if they wish to do so. As is invariably the case, these authorities were volunteers; and the Commission recognises the additional burden that its investigations placed on authorities who have many other pressing priorities.

C – *Normalised Performance Indicators* (NPI). Since these indicators are central to the methodology set out in the report, this appendix describes how they can be calculated for an authority or building.

D – *Internal rate of return*. Most authorities use simple pay-back calculations to evaluate investment opportunities. However, the rate at which benefits are expected to materialise needs to be taken into account; time costs money. This appendix provides a ready reckoner showing the internal rates of return for projects with varying lives and pay-back periods.

E – *A case example of energy management in Dorset County Council*. One of the advantages that local government has in the energy management field is the long and successful experience of many authorities. Dorset County Council is one. The final appendix shows how Dorset has successfully applied the principles recommended in the body of the report; it also demonstrates that, notwithstanding the county's enviable record, there remains apparent further worthwhile scope for improvement.

Appendix A

BIBLIOGRAPHY

The following documents are useful background reading on the management of energy.

- *Energy Efficiency and Local Authorities - a Good Practice Guide,* EEO, National Housing and Town Planning Council and the Association for the Conservation of Energy.
- CIPFA/SOLACE/LAMSAC, *Local Government Value for Money Handbook,* 2nd Volume.
- LAMSAC, *A Review of Energy Management in British Local Authorities,* 1982.
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- *Energy and Related Cost Savings in Local Authorities,* AMA (June 1985).
- STCELA (Standing Technological Conference of European Local Authorities, UK Energy Conservation Interest Group) *Guidelines for a Positive Local Authority Energy Policy,* 2nd edition 1982.
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- *Guidelines for Local Authority Shared Savings Energy Performance Contracts.* EEO, 1985.
- *Schemes and Services for Local Authorities,* EEO.
- *EEO booklet,* Degree Days.
- *Higher Returns with Energy,* EEO.
- *CIBS Building Energy Codes, Parts 1 to 4,* The Chartered Institute of Building Services.
- *Local Authority Energy Saving Incentive Schemes,* SCALA Occasional Paper No. 40.

Appendix B

AUTHORITIES PARTICIPATING IN THE SPECIAL STUDY

THE HOST AUTHORITIES

The Commission wishes to express its particular gratitude to the members and officers of the following authorities who agreed to participate in the special study:

Allerdale
Basingstoke and Deane
Brent
Cambridgeshire
Cheshire
Coventry
Darlington
Dorset
Essex
Leicester
Lincoln
Newcastle
New Forest
Oxford
Rhymney Valley
Richmond (London borough)
South Glamorgan
Stockport

Appendix C

NORMALISED PERFORMANCE INDICATORS

1. This appendix describes in turn how Normalised Performance Indicators (NPI) can be used to:
   - (i) Assess the energy efficiency of the buildings.
   - (ii) Determine the overall efficiency of the authority's building stock.

ASSESSING BUILDING EFFICIENCY

2. As part of the special study, a procedure has been devised for evaluating the relative energy efficiency of a building of a given type. This procedure is described in detail in the *Audit Guide on the Management of Energy in Local Authority Buildings.* The procedure relates the building's annual energy consumption to the area of the building. It first converts the building's use of all fuels for space heating, lighting, etc. into a common energy unit, kWh, and then adjusts (normalises) this for:
   - (a) the hours of use of the building relative to the national average hours of use for that category;
   - (b) the exposure of the building (i.e. whether sheltered, normal or exposed);
   - (c) the prevailing weather conditions in the locality using the tables of degree days published by the Department of Energy. The degree day is a measure of by how much and for how long the outside temperature is below 15.5°C. If the outside temperature remained at 14.5°C for each day of a week, a total of seven degree days would be accumulated. Degree-day figures provide a climatic correction and enable an allowance to be made when comparing energy consumption for one heating season with another. [See the EEO booklet No. 7 for more details.]

3. Although the type of construction of the building will undoubtedly affect energy consumption, it was not possible to find a universal factor which could be applied, since the effect was masked by the wide variation in consumption caused by other factors. The adjusted total energy consumption expressed in kWh is then related to the total floor area of the building*, and the result of the calculation expressed as kWh per square metre per annum. The procedure allows a consistent comparison to be made between buildings of the same type but with different hours of use, site exposure and prevailing weather conditions, or comparisons between different years for the same building.

4. The procedure is as follows:

Step	*Example*
1. Identify the consumption of each fuel used for heating	32,039 therms gas 65,784 units electricity
2. Convert the consumption of each fuel used for heating to kWh by multiplying by the appropriate conversion factor and sum to give a *heating sub-total*	938,743 kWh gas + 65,784 kWh electricity 1,004,527 kWh

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*The floor area is taken as the internal floor area, and includes internal walls, service spaces and corridors but excludes completely unused areas.

3. Multiply the heating sub-total by the appropriate exposure factor (say 0.9) and degree-day factor (say 1.05) to give an *adjusted heating consumption* (see *Audit Guide* for details)	949,278 kWh
4. Identify the consumption of each fuel used for non-heating purposes	3,212 therms gas 592,056 units electricity
5. Convert the consumption of each fuel used for non-heating purposes to kWh and sum to give a *non-heating sub total*	94,112 kWh gas + 592,056 kWh electricity = 686,168 kWh
6. Add totals of (3) and (5) to give a *total adjusted consumption.*	1,635,446 kWh
7. Factor the total adjusted consumption *pro rata* the national average hours of use for that category of building compared with the actual hours of use	Hours of use 2,253 hours Category Average 2,600 hours Factor 1.154 Factored Consumption = 1,887,305 kWh
8. Divide (7) by the floor area of the building to give a *Normalised Performance Indicator* (NPI)	Floor area 6,021 m^2 NPI = 1,887,305 ÷ 6,021 = 313 kWh per m^2 per annum

5. It is important to note that this approach concentrates on delivered energy units, rather than useful energy. Delivered energy for heating relates to the calorific value of the fuel delivered to the building, whereas useful energy relates to the heat actually distributed throughout the building, and is affected by the efficiency of the heating plant and the heat distribution system. Under normal circumstances the efficiency of heat generation would be about 75% for oil, gas and coal and 100% for some forms of heating by electricity, since the major distribution losses for electricity are incurred prior to the supply to the building. The efficiency of conversion for space heating and other purposes depends very much on the particular equipment and it would be inappropriate to assume a single conversion factor for particular fuels. The procedure here, therefore, concentrates on delivered energy. The rationale behind this approach is that delivered energy needs to be controlled in the long term. Authorities need also to pay attention to the efficiency of their plant and to the costs of different fuels. Since price relativities are liable to change it is difficult to design a robust performance assessment system based on energy costs.

6. It is also important to note that the yardstick NPIs, shown in Table 4 of the main report, are not targets in the sense that the term is used by energy management specialists. The term "target" is normally used to refer to an energy consumption to aim for in the short-term, e.g. next year. As Chapter One of the report makes clear, some buildings currently have an NPI double the yardstick NPI, and it would be unrealistic to expect these buildings to reduce their consumption to the yardstick figure without some capital investment in technical measures. *The CIB's Building Energy Code Part 4* explains how indicators such as our yardsticks can be used to determine targets for particular buildings.

AUTHORITY ENERGY PERFORMANCE RATING

7. This is calculated by first multiplying the yardstick NPI for each building by its floor area and summing over all the sampled buildings. This figure corresponds to the total normalised consumption if all buildings are as efficient as the yardstick. This total is then divided by the actual normalised consumption (calculated by multiplying the actual NPI for each building by its floor area and summing over all the sampled buildings) and the result expressed as a percentage. For example, if the actual normalised total consumption is 54 million kWh, and the hypothetical consumption if all buildings were as efficient as the yardsticks is 38 million kWh, then the authority's energy performance rating is 70%.

Appendix D

INTERNAL RATE OF RETURN

The table below shows the internal rates of return for schemes with varying project lives and payback periods, constructed on the basis of constant prices with no allowance for increases in fuel prices. A project with a payback period of three years and an expected life of six years has a real internal rate of return of 25%. For public sector investments generally, the Treasury requires a real rate of return in excess of 5%. By this criterion, all energy-efficiency measures with a project life of a few years greater than their payback period would be judged viable. Businesses generally demand a real rate of return of more than 10%, and by this criterion most schemes with a payback period of less than six years would prove viable. In the Table, schemes falling below the zigzag line have internal rates of return below 5% and therefore would be judged non-starters by the Treasury criterion. Whether schemes above the line should be invested in depends on the current real cost of capital and on the rates of return from competing bids for investment in other spheres of the authority's activity (e.g. new computers). The real cost of capital over the last two decades has been estimated to vary between −2% and +4%.

Table: INTERNAL RATES OF RETURN FOR PROJECTS WITH VARYING LIVES AND PAYBACK PERIODS

Payback period (years)	Project life (years)									
	3	4	5	6	7	8	9	10	15	20
2	24%		Very							
3		13	20	25		large				
4		Less	8	13	17	19	21	22		
5		than		6	9	12	14	15	18	19
6		5				7	9	10	15	16
7							5	7	11	13
8									9	11
9									7	9

Appendix E

CASE EXAMPLE: DORSET COUNTY COUNCIL

1. As the report makes clear, there are many examples of local authorities in England and Wales with excellent records of achievement in the energy management field. Dorset County Council is one. The purpose of the Appendix is first, to describe the present situation in the County drawing on the County Architect's 1984 Annual Report on *Energy Conservation* to the Policy and Resources Committee. Next, the Appendix shows the results of the Energy Audit carried out during the study; this audit suggests that, not withstanding the efforts of the past several years which have already saved over £4 million, there remains further worthwhile scope for improvement.

THE PAST RECORD

2. Dorset County Council has had an active Energy Conservation Programme underway since the second oil crisis. The following table shows the trend in energy consumption since 1978-79.

Table E-1: ENERGY CONSUMED BY DORSET COUNTY COUNCIL BUILDINGS % Change

FY	1979	1980	1981	1982	1983	1979–83 %change
Oil (m litres)	12.1	8.8	8.6	8.4	7.3	–40%
Electricity (m units)	29.5	28.6	28.0	27.9	28.4	–4
Gas (m therms)	3.7	3.4	3.3	3.7	3.2	–14

3. In 1982-3 the actual expenditure on fuels, including coal, calor gas and water was £3.80 million. This was approximately the same as in the previous year and is the first time that this has been achieved, reflecting a slowing of the rate of inflation as well as a continuing reduction in the level of fuel consumed. If the Authority had continued to consume oil, gas and electricity at the 1978–9 level, the total bill for those fuels at 1982–3 prices would be £4.65 million. For a total investment of £1.48 million the cumulative saving to 1983 is £2.96 million. Now that Dorset has reached a position of saving over £1 million per annum, compared with 1978–9, tariffs are constantly reviewed. In the last 12 months, 24 tariffs have been changed, which are yielding an additional saving of £12,000 per annum. For the fourth year in succession, the County Council was awarded a Gas Energy Management Award by British Gas. This was in recognition of the high level of savings achieved at Ferndown Sports Centre, where new plant and a pool cover have reduced fuel consumption by 49%, which over the last 12 months represents a financial saving in the order of £17,000.

4. Although the County Architect had earlier suggested that at some future date the opportunity for economic investment in energy conservation would become more difficult, this stage has not yet been reached. In fact, improved monitoring of energy use is revealing areas where further investment is worthwhile. In 1983–84, the investment approved for energy conservation measures by the Policy and Resources Committee was £357,100, and £19,000 by the Social Services Committee. This was spent on a range of projects which from past experience have an average payback of between two and three years. The Social Services budget was spent solely on cavity-wall insulation to 13 properties.

5. The following energy management initiatives are currently underway:

(i) **Building and engineering measures.** The main thrust of the energy conservation programme, as in previous years, is concerned with the identification of where adaptations to the building fabric and engineering services in County buildings are likely to achieve the most effective return on the capital invested. The fuel consumption at every County property is recorded on a computerised system. As this has now been operating for several years, the process of identifying where economies can best be achieved is a process of systematic analysis. Accordingly, during 1982–83, energy conservation work was undertaken in 150 properties, expenditure ranging from a few pounds to £8,000. The type of work included:

- New draught lobbies
- Wall insulation
- Reduction in glazed areas
- Water saving devices
- New control systems
- Small alterations and adjustment to controls
- More efficient lighting
- Installation of equipment which turns lighting off at predetermined times.

Whenever a rewire or new electrical installation is planned, the use of higher-efficiency lighting and careful grouping of switches is seriously considered. In the new extension to Portland Modern School this represents a reduction of energy used for lighting of 45%, a saving of £1,500–£2,000 per annum.

Further development could lead to reductions of energy in future lighting installations of an additional 10%.

(ii) **Energy management systems and plant monitoring.** The Policy and Resources Committee has agreed to invest in a computerised energy management system. The essence of this system is that as the larger properties have a considerable number of individual controls of various sorts and in a variety of locations, these should be linked into a computer system, enabling all of them to be controlled from a central processor located in County Hall.

- The initial site selected for the installation of this equipment was the Bournemouth and Poole College of Further Education at the Lansdowne, where a major boiler replacement was having to be carried out. The equipment has been in operation since the end of November 1983, and it is already apparent that much better monitoring of plant and temperatures will be possible. Significant energy savings will be achieved in this building despite the fact that the equipment will not come into operation until the commencement of the heating season. These energy savings would be impossible to achieve using the normal control commissioning method.
- The second system was installed at the Portland Secondary School, as part of the major extensions being undertaken there, and became operational when the new building was occupied in the spring of 1984.
- Further systems are planned at Colfox School, County Hall and the College of Agriculture, when the planned boiler replacement programmes are undertaken at each of these properties.

(iii) **Water conservation.** A programme of installation of water saving devices, designed in-house, has been commenced to restrict the maximum flow in taps and to reduce the rate of automatic cistern flushing outside the normal hours of occupation. Whilst water may not be regarded as a "fuel" in the strict sense of the word, the Authority has an annual water bill in excess of £0.25 million. Clearly there is room for considerable savings to be made here. The Architects Department, in collaboration with private industry, has developed a device which is now being installed on automatic systems in County properties, and should achieve significant reductions in water consumption where incorporated. It is also to be noted that this device is being marketed commercially. It is proposed to extend this programme to all County buildings where an appropriate saving in water consumption can be achieved.

(iv) **Cavity-wall insulation.** During the course of the 1982–3 financial year the Committee made available an additional sum of £130,000 over and above the approved Energy Conservation Budget, which was spent on a programme of cavity-wall insulation to 42 properties. Many of these properties had suffered from under-heating problems. The opportunity was taken either to fine tune the existing controls at these properties, or to provide new ones, so that the return on this expenditure can be accelerated.

(v) **Motivating building users.** A most significant factor in the achievement of energy savings in individual properties will be always be the motivation and commitment of those who occupy the property. For a number of years heavy reliance was placed on the innovation and design skills of energy management unit staff along with exhortation of building users to persuade people to save energy. However, the County Architect has concluded that exhortation has reached its limits: people want to be consulted and involved. They want full information on the scale of the problem; they want to be consulted and involved in the search for the solutions and they want appropriate incentives for their ideas and help. Attempts to establish a fair incentive scheme have been under discussion. Dorset, with four of its neighbouring authorities, is looking specifically at this problem with the Department of Energy and the universities of Bristol and Bath.

FURTHER SCOPE FOR IMPROVEMENT

6. Against this background of an aggressive and successful energy management programme maintained over several years, the study team applied the approach described in the main body of this report. The end product of this effort was an *Energy Management Audit Report* (EMAR). This identified the Energy Efficiency Rating (EER) for over 230 separate buildings accounting for over 70% of Dorset's energy expenditure.

7. The report shows the authority energy rating, against the efficiency yardstick. That is, if all buildings were operating at the efficiency yardstick levels in energy consumption terms, the authority rating would be 100%. [The overall rating, of course, masks differences between buildings]. Some buildings can have an efficiency of better than 100%, since the efficiency yardstick is not as aggressive as the performance already being achieved in some buildings in local government.

8. So far as Dorset is concerned, the *Energy Management Audit Report* findings were relatively impressive. They showed that, overall, Dorset ranked second among the large authorities studied, with an authority rating of 84%. Nonetheless, the report calculates that the County's annual energy expenditure in the buildings analysed would be reduced further by some 16% – £421,000 at current energy input prices – if all buildings were operated at or near the efficiency yardstick. Table 2, below, summarizes the efficiency rating by category of buildings.

Table 2: ENERGY EFFICIENCY IN DORSET
1985 (234 sample buildings)

Building category	Number analysed	Efficiency rating (%)
Primary schools (no pool)	57	91
Primary school (indoor pool)	1	87
Secondary schools (no pool)	59	86
Secondary schools (indoor pool)	8	67
Special schools	5	129
Further education colleges	5	87
Old persons' homes	36	82
Day centres	12	71
Residential homes	18	69
Libraries	17	92
Adult training centre	6	92
Main offices	1	132
Small offices	1	143
Miscellaneous	8	–

9. Overall, the social services' energy efficiency rating was somewhat lower than that for the education buildings (80% vs 84%) or for the other services' buildings examined (117%). However, in general, Dorset's performance is commendable even though there are a number of buildings that, from the information provided, are costing more than would appear to be necessary. The report identified these buildings individually, as shown in the attachments to this Appendix, and illustrated in Exhibits E–1 and E–2.

10. The next step, therefore, will be to undertake detailed energy surveys in those buildings identified in the attachment as having poor energy ratings, which cannot be explained by factors outside the control of the users of the building, or the authority – such as, most importantly, the nature of the construction of the building.

11. The pages following the Exhibits show how the energy efficiency of the authority's buildings compare with the national indicators, in particular with the yardsticks shown in Table 4 of the main report. Each page is devoted to one particular category of building, which is given a code reference on the top figure but is given its full title below in the section entitled "category performance".

12. At the top of each page is a histogram which includes all of the authority's buildings in that particular category selected for analysis. For example, the first page shows a histogram for the 57 buildings selected in category E1 – primary schools with no indoor pool. It can be seen that there are 13 buildings with an NPI between 100 and 150, 22 buildings with an NPI between 150 and 200, and so on.

- The average NPI for all the authority's buildings in a category is called the Category Normalised Performance Indicator, abbreviated CNPI. The value of the CNPI is displayed above the histogram and its approximate location denoted by a small hat symbol (the key below the histogram shows the symbols used). In this instance, the CNPI is 196 kWh/m^2/annum, which is about 9% above the efficiency yardstick of 180 kWh/m^2/annum, indicated by an asterisk on the histogram. The efficiency rating for this category is 91%, implying that a 9% reduction in energy could be achieved if the average efficiency could be brought up to yardstick.
- On the histogram a small cross denotes the approximate location of the indicator of poor efficiency (as given in Table 4) and a small vertical line shows the approximate location of the national average NPI for that category, 260 for category E1. At

Exhibit E–1

Dorset County Council

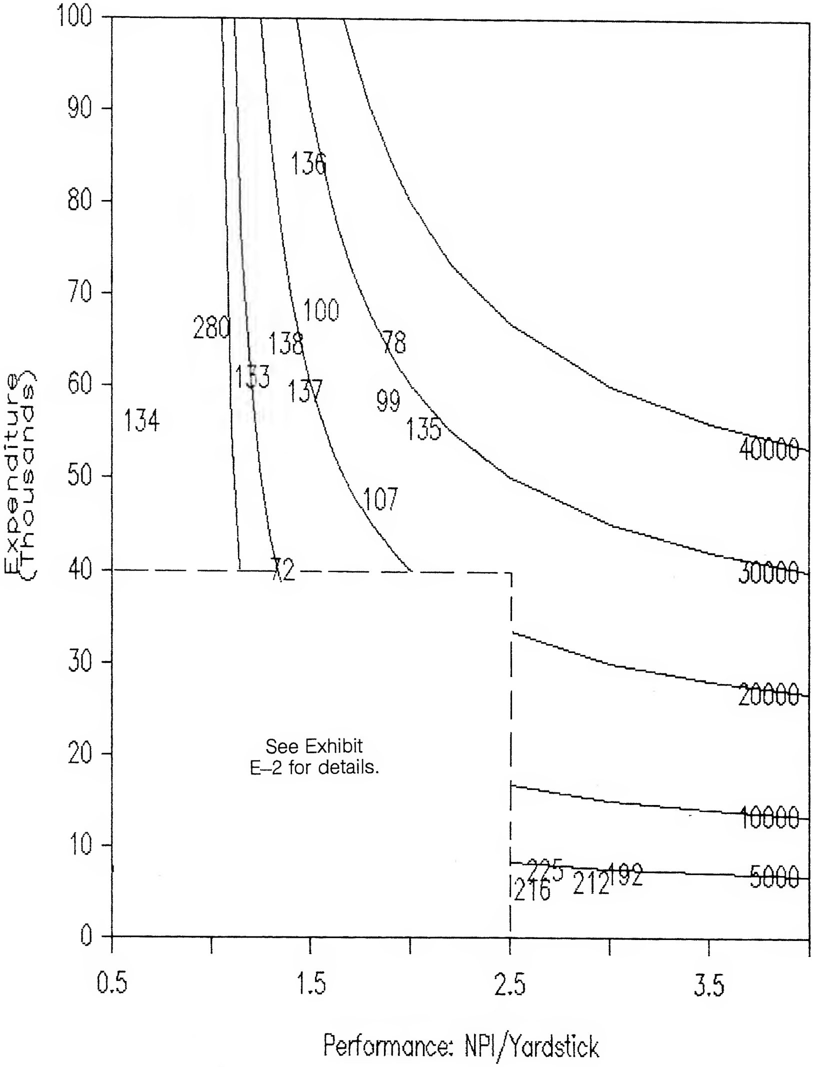
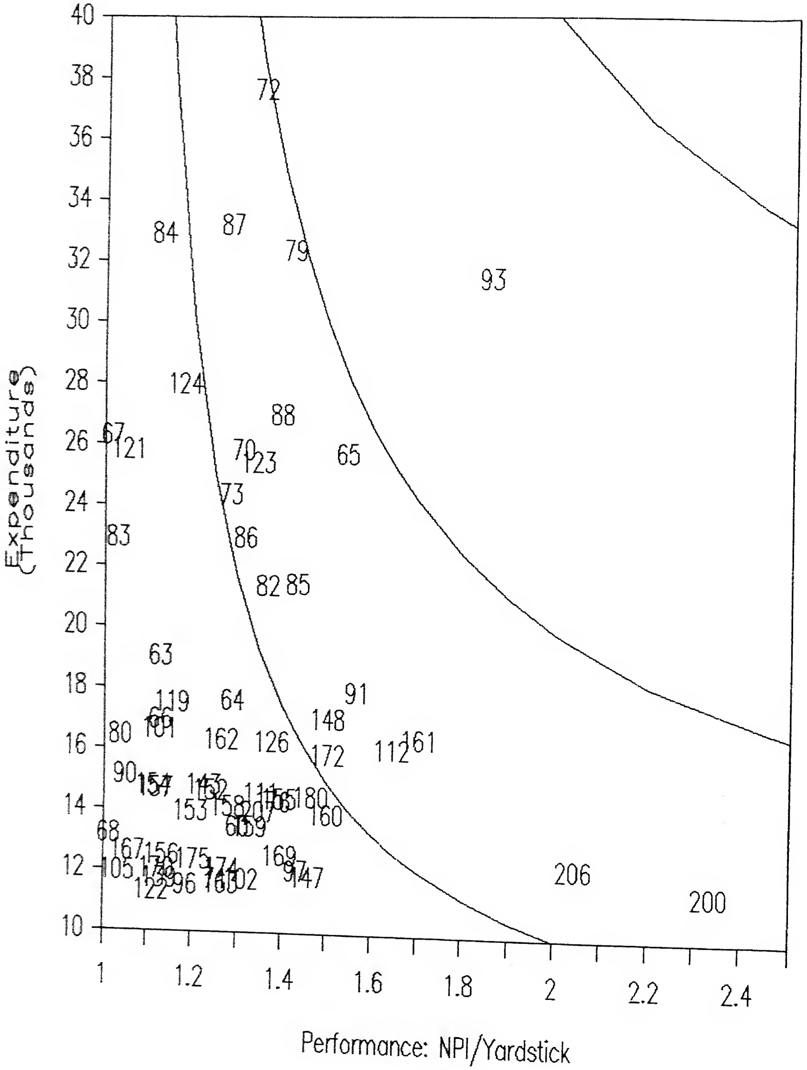
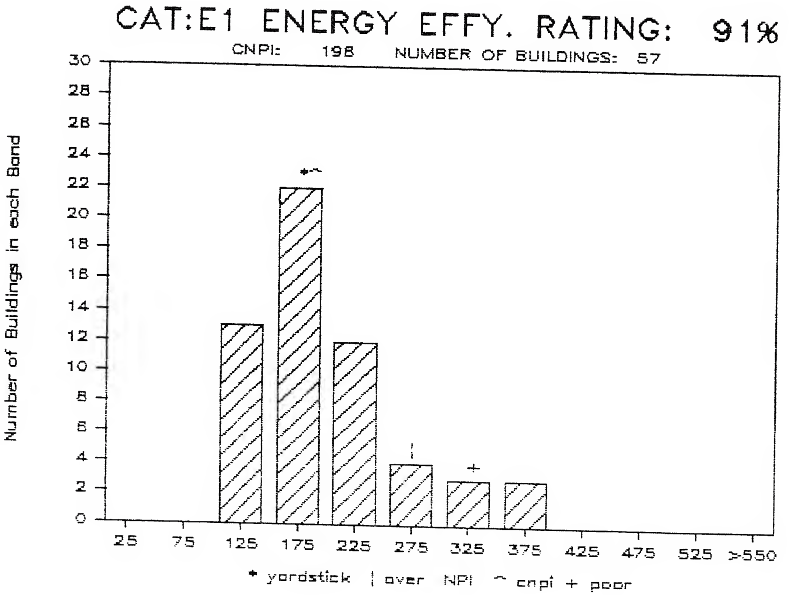


Exhibit E-2

Dorset County Council



the bottom of each page, in a section labelled "category performance", is a list of the buildings in each category which are below the national average efficiency (i.e. have an NPI *above* the national average NPI). In the case of category E1, there are eight buildings which are worse than the national average. These buildings warrant attention.

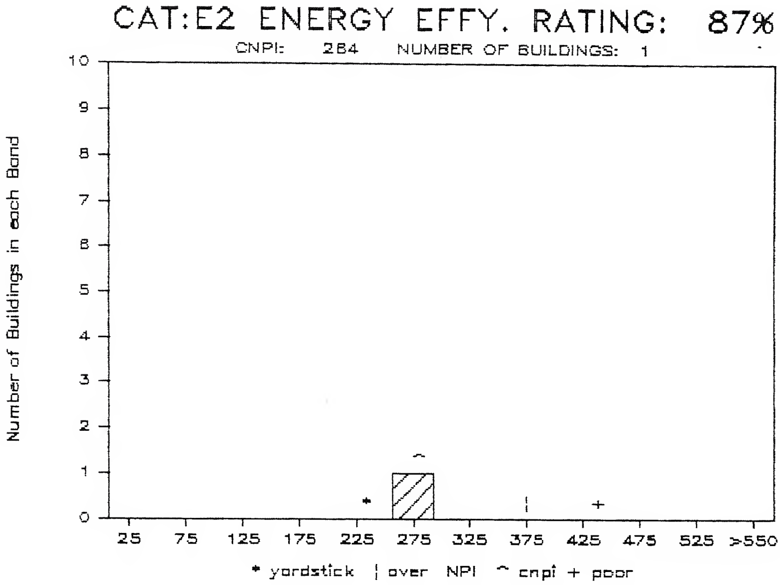


CATEGORY PERFORMANCE

CATEGORY E1 Primary School - No indoor pool
AVERAGE NPI : 260 kWh/m2/annum
TOTAL NUMBER OF BUILDINGS 57

BUILDINGS BELOW NATIONAL AVERAGE

BUILDING NUMBER	BUILDING TITLE	NPI kWh/m2/Annum
18	Kings Park First Sch Ashley Rd Bournmth	396
6	Christchurch Junior Sch., Clarendon Rd	366
19	Moordown St. Johns CE, Bournemouth	364
2	Archbishop Wake CE Prim. Sch., Blindford	329
30	St Mary's RC Primary School, Dorchester	310
39	Stanley Green First School, Poole	308
40	Stourfield First School, Bournemouth	292
15	Heathlands First School, Bournemouth	270



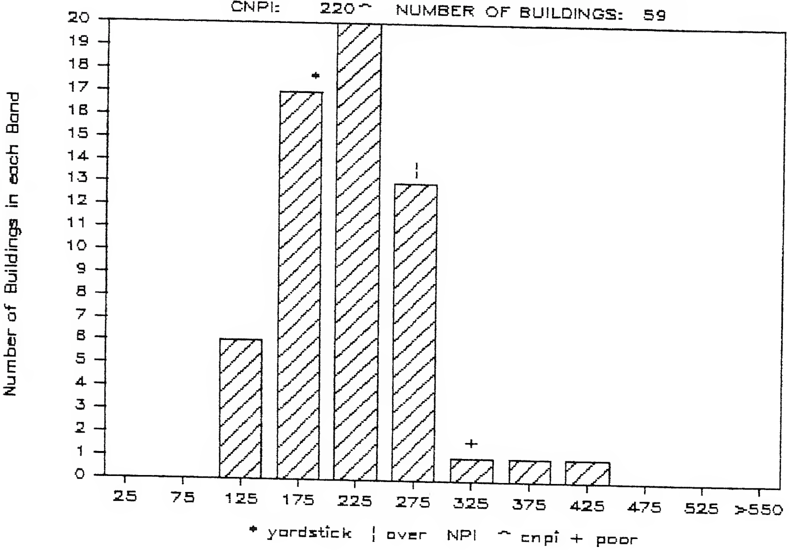
CATEGORY PERFORMANCE

CATEGORY E2 Primary School with indoor pool
AVERAGE NPI : 350 kWh/m2/annum
TOTAL NUMBER OF BUILDINGS 1

BUILDINGS BELOW NATIONAL AVERAGE

BUILDING NUMBER	BUILDING TITLE	NPI kWh/m2/Annum
No buildings below national average		

CAT:E3 ENERGY EFFY. RATING: 86%



CATEGORY PERFORMANCE

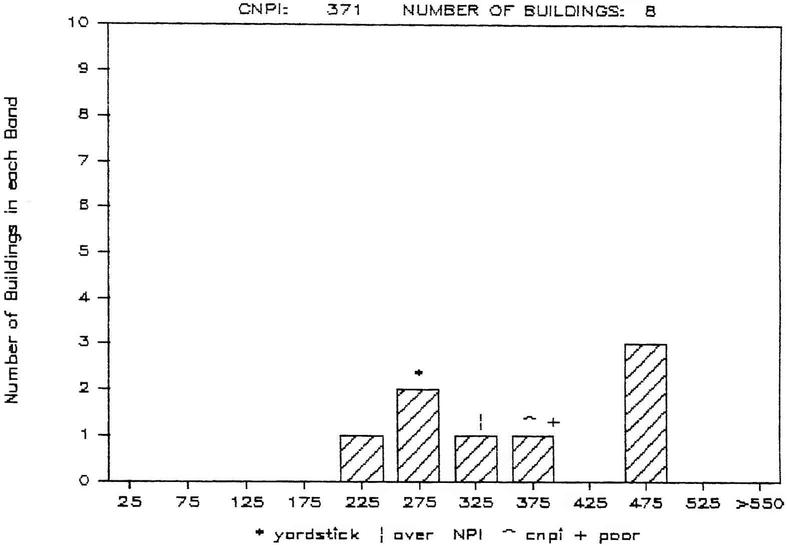
CATEGORY E3 Secondary School - no indoor pool
AVERAGE NPI : 250 kWh/m2/annum
TOTAL NUMBER OF BUILDINGS 59

BUILDINGS BELOW NATIONAL AVERAGE

BUILDING NUMBER	BUILDING TITLE	NPI kWh/m2/Annum
120	Westham Modern Lower School, Weymouth	438
93	Oakmead School for Boys, Bournemouth	353
112	Shaftesbury Grammar Sch, Salisbury St	313
91	Milldown CE Middle School, Blandford	298
65	Blandford Upp Sec Sch, Milldown Road	294
108	St Osmunds CE Middle School, Dorchester	287
76	Dorchester Middle School, Queens Avenue	278
97	Portchester Boys Sch Annx Portchester Rd	273
85	Herbert Carter Secondary Sch, Hamworthy	272
118	West Moors Middle School, Wimborne	271
79	Gillingham School, Hardings Lane	271
88	Kingsleigh Sec. School, Bournemouth	266
82	Grange School Somerford Christchurch	260
111	Seldown Boys Secondary Mod Sch, Poole	257
123	Woodroofe Comprehensive Sch, Lyme Regis	256
86	Highcliffe Comp. Sch., Christchurch	251

CAT:E4 ENERGY EFFY. RATING: 67%

CNPI: 371 NUMBER OF BUILDINGS: 8

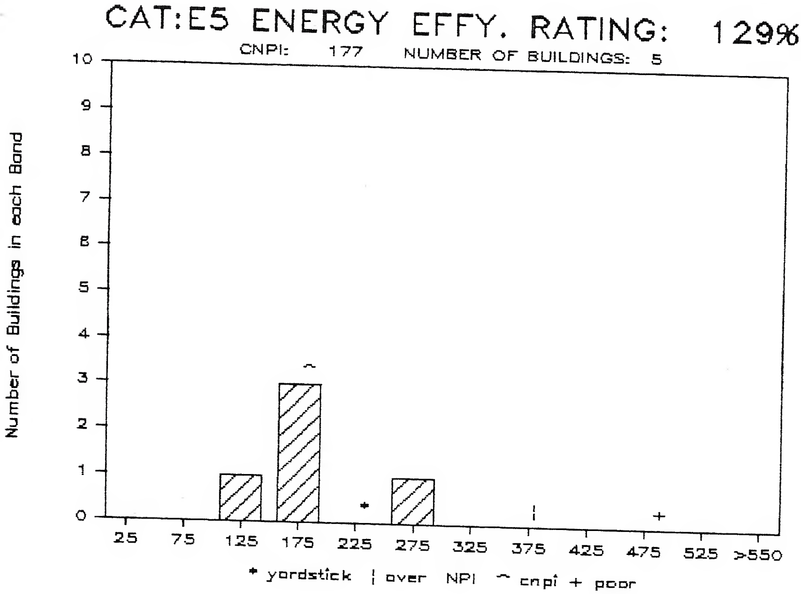


CATEGORY PERFORMANCE

CATEGORY E4 Secondary School with indoor pool
AVERAGE NPI : 320 kWh/m2/annum
TOTAL NUMBER OF BUILDINGS 8

BUILDINGS BELOW NATIONAL AVERAGE

BUILDING NUMBER	BUILDING TITLE	NPI kWh/m2/Annum
78	Ferndown Upper School, Wimbourne	479
99	Purbeck Secondary School, Wareham	471
107	St Peter's RC Sec Sch Southbourne Brnmth	461
100	Queen Elizabeth Sec Sch, Wimborne	387
72	Castlefield Compre Sch, Dorchester	339

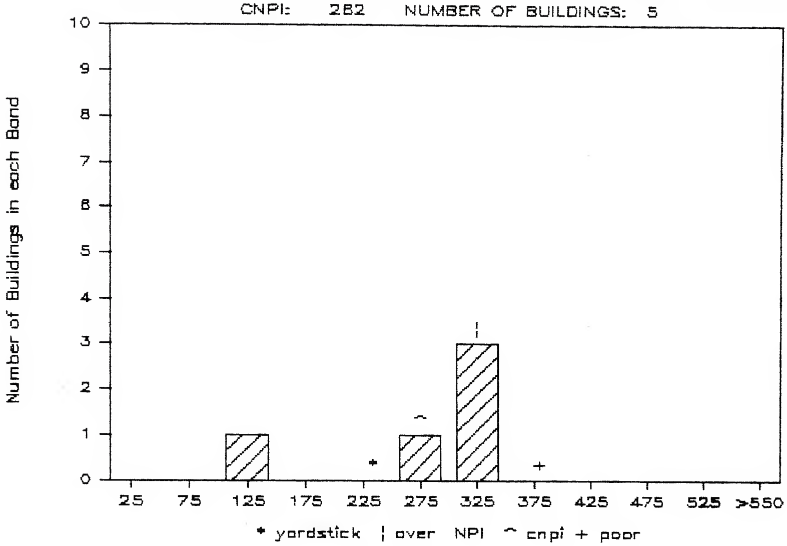


CATEGORY PERFORMANCE

CATEGORY E5 Special School
AVERAGE NPI : 370 kWh/m2/annum
TOTAL NUMBER OF BUILDINGS 5

BUILDINGS BELOW NATIONAL AVERAGE

BUILDING NUMBER	BUILDING TITLE	NPI kWh/m2/Annum
No buildings below national average		


CAT:E6 ENERGY EFFY. RATING: 87%

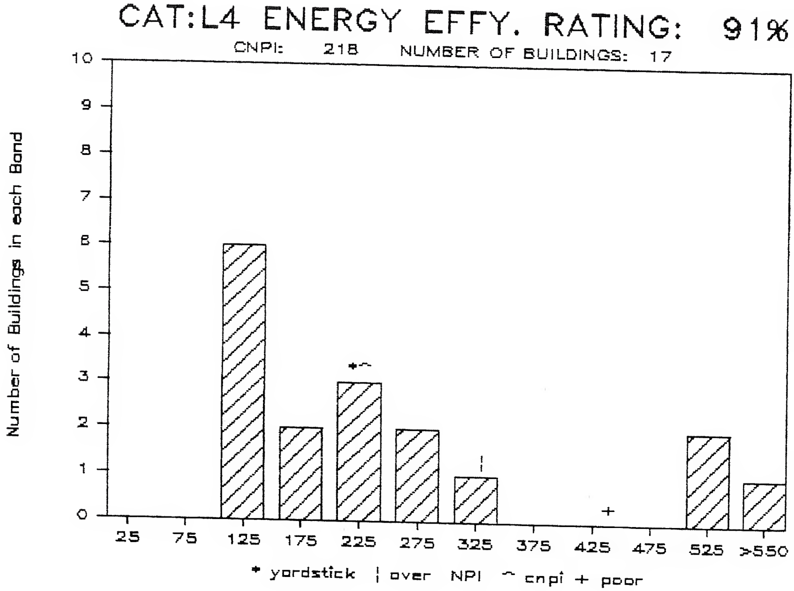
CNPI: 282 NUMBER OF BUILDINGS: 5

CATEGORY PERFORMANCE

CATEGORY E6 College of Further Education
AVERAGE NPI : 300 kWh/m2/annum
TOTAL NUMBER OF BUILDINGS 5

BUILDINGS BELOW NATIONAL AVERAGE

BUILDING NUMBER	BUILDING TITLE	NPI kWh/m2/Annum
136	Dorset Inst. of FE, Wallisdown Rd Poole	342
137	Dorset Inst of HE, Cranford Ave Weymouth	338
138	South Dorset Tech College, Weymouth	315

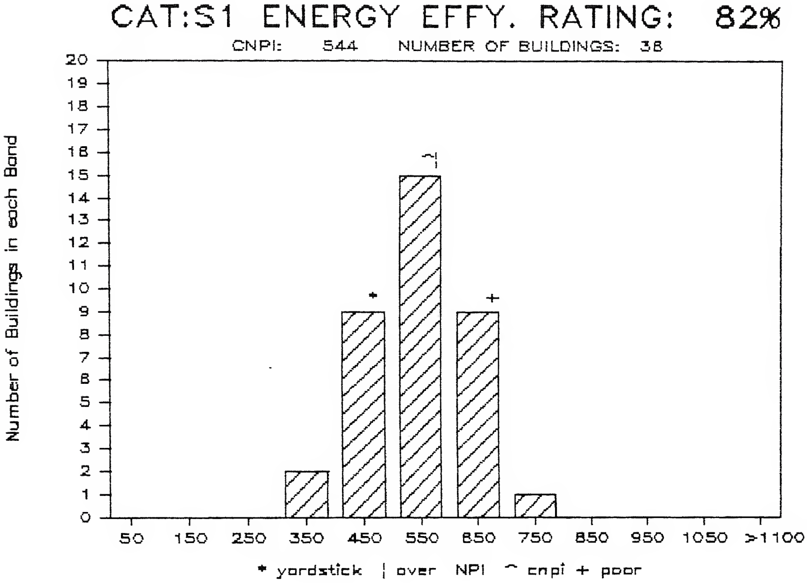


CATEGORY PERFORMANCE

CATEGORY L4 Library (Museum/Art Gallery)
AVERAGE NPI : 320 kWh/m2/annum
TOTAL NUMBER OF BUILDINGS 17

BUILDINGS BELOW NATIONAL AVERAGE

BUILDING NUMBER	BUILDING TITLE	NPI kWh/m2/Annum
212	Canford Heath Library, Poole	581
225	Weymouth Library, Westwey Road	535
216	Highcliffe Library, Christchurch	523
217	Kinson Library, Bournemouth	323

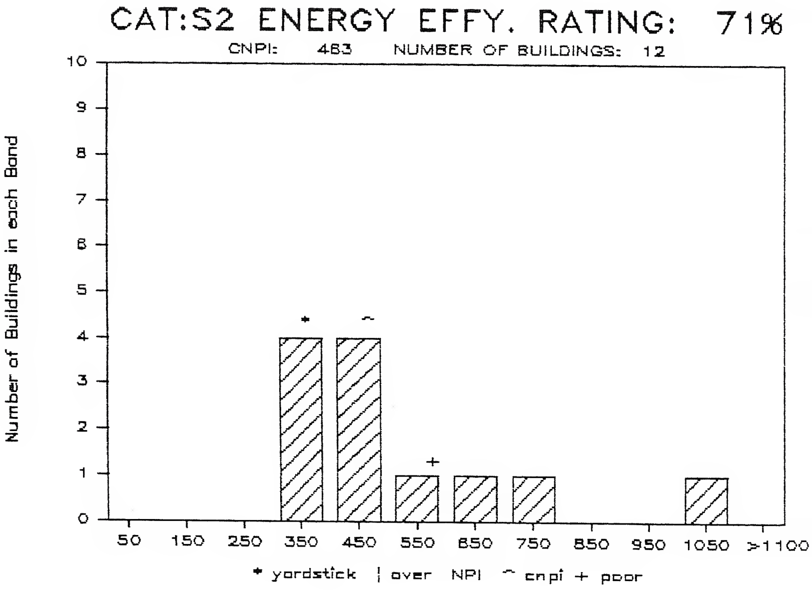


CATEGORY PERFORMANCE

CATEGORY S1 Elderly Persons Home
AVERAGE NPI : 570 kWh/m2/annum
TOTAL NUMBER OF BUILDINGS 36

BUILDINGS BELOW NATIONAL AVERAGE

BUILDING NUMBER	BUILDING TITLE	NPI kWh/m2/Annum
161	Hayes EPH, Long Street, Sherborne	767
148	Avon View EPH, Christchurch	677
172	Riverhouse EPH, Streche Rd, Wareham	677
160	Fairlawn EPH, Ferndown, Wimbourne	675
180	Turbary Heights EPH Wallisdown Bournemth	660
147	Alexandra House EPH, Parkstone, Poole	657
169	Leybourne House EPH, Western Ave, Brnmth	630
155	Castleman Hse EPH Salisbury Rd Blandford	628
176	Streets Meadow EPH Hanham Rd Wimborne	622
150	Bourne House EPH, Parkstone, Poole	605
159	Elizabeth House EPH, Parkstone, Poole	598
158	Draper Hse EPH, Northbourne, Bournemouth	576
177	Swanmore EPH, Victoria Ave., Swanage	574
174	Shalden Grange EPH, Watkin Rd, Boscombe	571

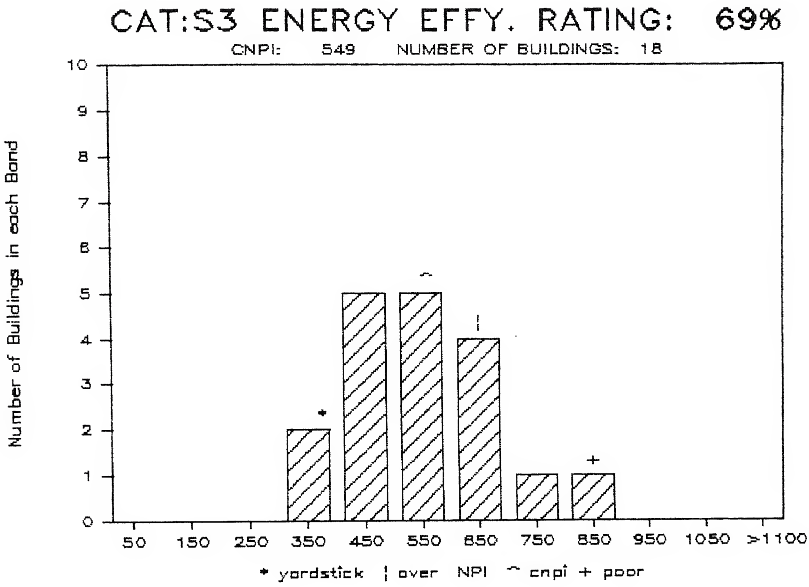


CATEGORY PERFORMANCE

CATEGORY S2 Day Centre/Day Nursery
AVERAGE NPI : 460 kWh/m2/annum
TOTAL NUMBER OF BUILDINGS 12

BUILDINGS BELOW NATIONAL AVERAGE

BUILDING NUMBER	BUILDING TITLE	NPI kWh/m2/Annum
192	Poole Day Nursery Ashley Rd Parkstone	1015
191	Poole Day Centre, Parkstone, Poole	707
190	Nortoft Day Centre, Bournemouth	656
185	Alumhurst Day Centre, Westbourne	595
186	Bournemouth Day Nursery, Lansdowne Rd	469

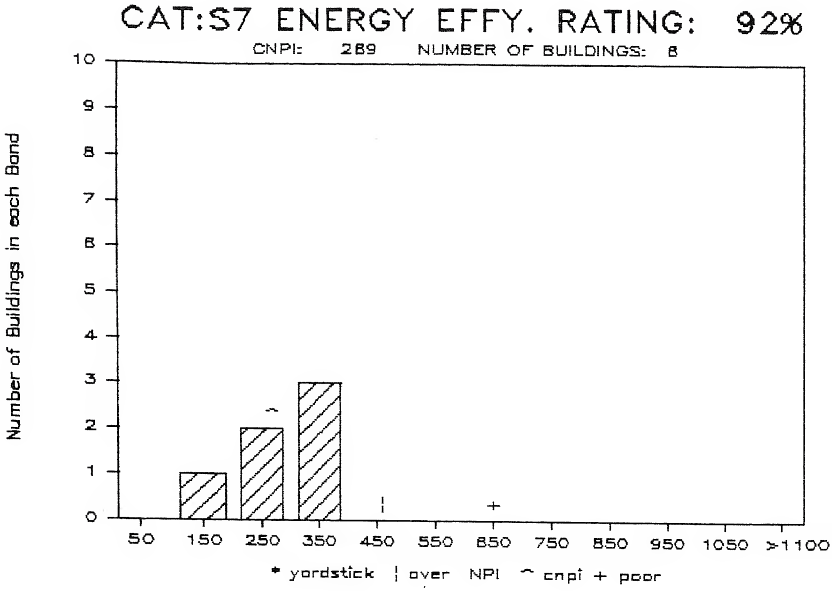


CATEGORY PERFORMANCE

CATEGORY S3 Residential Homes
AVERAGE NPI : 600 kWh/m2/annum
TOTAL NUMBER OF BUILDINGS 18

BUILDINGS BELOW NATIONAL AVERAGE

BUILDING NUMBER	BUILDING TITLE	NPI kWh/m2/Annum
200	Observation & Assessment Cen. Bournemth	888
206	Carlton Rd Nr. Hostel for M.H. Weymouth	778
274	Beeches Fairfield Bungalows Blandford	694
197	Accom. for Adolescent Girls Bournemouth	666
203	Whitecombe Childrens Home, Parkstone	609
204	Probation Hostel Lwr Bond St Weymouth	609

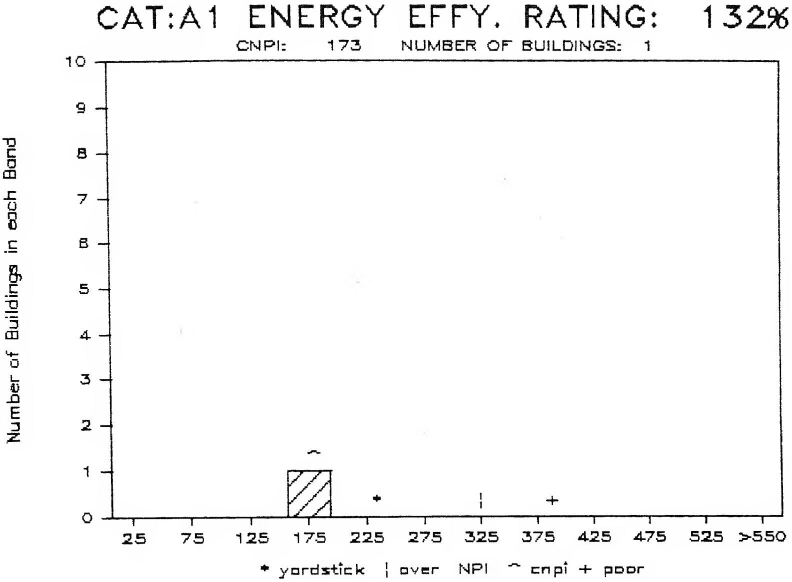


CATEGORY PERFORMANCE

CATEGORY S7 Adult Training Centre
AVERAGE NPI : 440 kWh/m2/annum
TOTAL NUMBER OF BUILDINGS 6

BUILDINGS BELOW NATIONAL AVERAGE

BUILDING NUMBER	BUILDING TITLE	NPI kWh/m2/Annum
	No buildings below national average	



CATEGORY PERFORMANCE

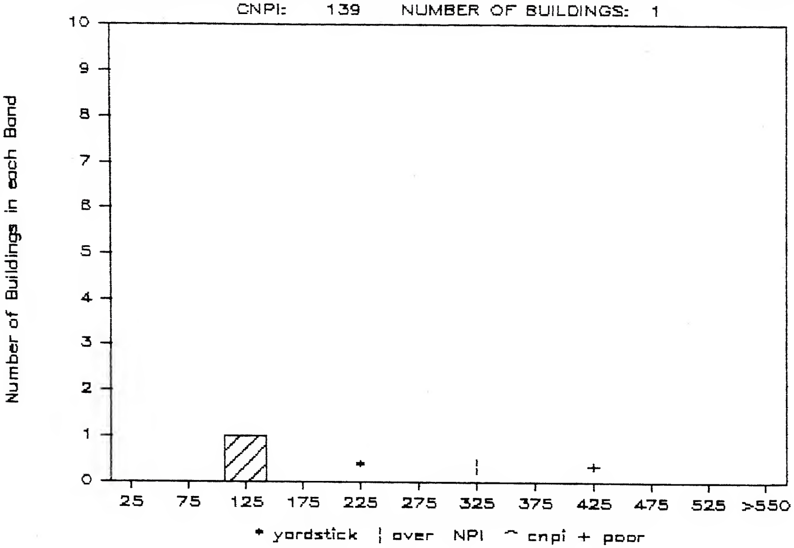
CATEGORY A1 Offices over 2000 sq. metres
AVERAGE NPI : 310 kWh/m2/annum
TOTAL NUMBER OF BUILDINGS 1

BUILDINGS BELOW NATIONAL AVERAGE

BUILDING NUMBER	BUILDING TITLE	NPI kWh/m2/Annum
No buildings below national average		

CAT:A2 ENERGY EFFY. RATING: 143%

CNPI: 139 NUMBER OF BUILDINGS: 1



CATEGORY PERFORMANCE

CATEGORY A2 Offices less than 2000 sq. metres
AVERAGE NPI : 300 kWh/m2/annum
TOTAL NUMBER OF BUILDINGS 1

BUILDINGS BELOW NATIONAL AVERAGE

BUILDING NUMBER	BUILDING TITLE	NPI kWh/m2/Annum
	No buildings below national average	

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